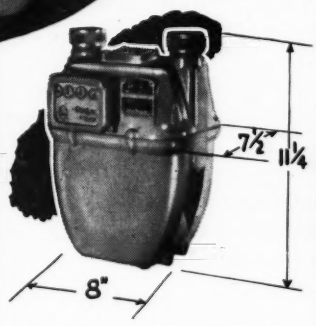
NO OTHER METER

gives you so many money saving features . . . so much value and convenience

CAST ALUMINUM CASE

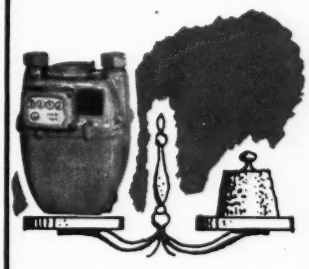
Defies the elements. Has high impact strength. Won't rust or corrode



COMPACT DIMENSIONS

Fits easily into tight places. Ideal for conserving space on multiple settings

ONLY 11½ POUNDS



LIGHT WEIGHT

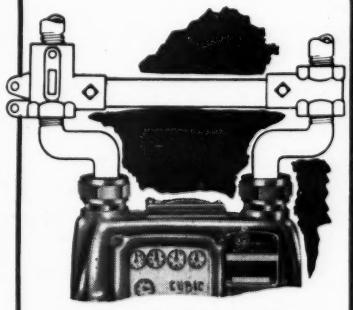
Meter weighs only 11½ lb. Saves in shipping, handling, installation costs

BOWL TYPE BODY

No troublesome side plates. Only one external gasket to seal

STEEL SPUDS

Give added strength. Threads won't gall

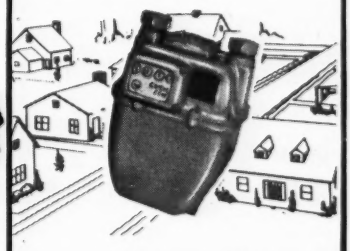


EASILY INTERCHANGES

With all makes through suitable connections; tin meter bars

ADJUSTMENT CONVENIENCE

Hand hole plate in cover permits easy tangent adjustment



AMPLE CAPACITY

Up to 150 cfh of 0.60 sp. gr. gas at ½ in. W.C.

ROCKWELL-EMCO NO. 00 GAS METER

with pressure cast aluminum alloy case

SERVICE EASE

Entire working mechanism is easily replaceable as a unit with either a new or factory rebuilt assembly in proof and ready to go

Write for Bulletin 1163

ADVERTISERS

American Meter Co. —
American Radiator & Standard Sanitary Corp. 59
American Recording Chart Co. 76
Anchor Petroleum Co. 74
Armstrong Co., Richard M. 79

Barrett Division, The 97
Blaw-Knox Co. 7
Bryant Heater Division 60

Caloric Stove Corp. —
Carbide & Carbon Chemicals Division, Union Carbide & Carbon Corp. 70
Cast Iron Pipe Research Association 4, 5
Chaplin-Fulton Manufacturing Co. —
Cleveland Trencher Co., The 64
Combustion Engineering-Superheater, Inc. 46
Connelly, Inc. 80
Consolidated Engineering Corp. —
Cooper-Bessemer Corp., The —
Crane Co. 22
Cribben & Sexton Co. 53
Crose Manufacturing Co., M. J. 109

Day Co., S. D. 112
Detectron Co., The —
Detroit Brass & Malleable Works 18
Detroit-Michigan Stove Co. —
Dowell, Inc. 91
Dresser Industries, Inc. 3, 45, 73
Dresser Manufacturing Division 3, 45

Empire Stove Co. 49
Evans Sales Co., G. S. 77

Fisher Governor Co. 16
Fisher Research Laboratory, Inc. 110
Fluor Corp., Ltd. 88

Gama Industries, Inc. 111
Gas Appliance Manufacturers Assoc. 63
Gas Machinery Co., The —
General Controls Co. 83
General Gas Light Co. 57
Greenlee Tool Co. —

Hardwick Stove Co. 67
Hays Manufacturing Co. 82
Heath Tree Service, Inc. 84
Hydrauger Corp., Ltd. —

Johns-Manville Corp. 77

Kaiser Steel Corp. 105
Kitson Division, The Welsbach Corp. —
Koppers Co., Inc. 12

Lancaster Meter Parts Co. 72
Latex Construction Co. —

Mettler Co., Lee B. —
Middle West Coating & Supply Co. 111
Milwaukee Gas Specialty Co. 65
Minneapolis-Honeywell Regulator Co. —
Mueller Co. —
Murray Corp. of America, The 81

National Tube Co. —
Natural Gas Odorizing Co. 6
Nordstrom Valve Division Rockwell Manufacturing Co. 8, 9
Norton-McMurray Manufacturing Co. 68
Norwalk Valve Co. 84

Oronite Chemical Co. Third Cover

Pathfinder Co. 112
Payne Furnace Division Front Cover
Peerless Manufacturing Corp. 85
Phillips Petroleum Co. 13
Pittsburgh Equitable Meter Division Rockwell Mfg. Co. 1
Price Co., H. C. —

Refinery Supply Co. 107
Reliance Regulator Division Second Cover
Reynolds Gas Regulator Co. 66
Robertshaw-Fulton Controls Co. —
Roots-Connersville Blower Corp. 73
Roper Corp., Geo. D. —

Safety Gas Main Stopper Co. —
Security Manufacturing Co. 75
Selas Corp. of America 14
Servel, Inc. —
Sharples Chemicals Inc. 11
Skinner Co., M. B. 93
Smith Corp., A. O. 43
Sprague Meter Co. Fourth Cover
Stacey Manufacturing Co., The 84
Standard Pipeprotection, Inc. —
Stauffer Manufacturing Co. 80
Stewart-Warner Corp. 54
Superior Meter Co., Inc. —

Thomas & Associates, Inc., H. Emerson 86
Titan Valve & Manufacturing Co. —
Toledo Pipe Threading Co. 69
Trojan Construction Co. 111
Tulsa Pipe Coating Co. 110

U. S. Pipe & Foundry Co. —
Union Carbide & Carbon Corp. Carbide & Carbon Chemicals Division 70
United Engineers & Constructors, Inc. 10
United Petroleum Gas Co. 86
United States Steel —
Utility Control Co. —

Vulcan Rubber Products, Inc. 78

Walworth Co. 99
Ward Heater Co. 51
Warren Petroleum Corp. 20
Webster Engineering Co. —
White Products Corp. —
White-Rodgers Electric Co. 71
Williamson, Inc., T. D. 108
Worthington Pump & Machinery Corp. 102

GAS

REG. U. S. PATENT OFFICE

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Twenty-Sixth Year of Publication

September, 1950 CCA NBP Vol. 26—No. 9

COMMENT

Highlights 15
Thermally Thinking, *by Edward Titus* 17
Technical Trends, *by Guy Corfield* 19
Promotional Notes and Notions, *by Stanley Jenks* 21

ARTICLES

How Minneapolis Boosted Gas Sales Seven-Fold, *by Harry K. Wrench* 23
Service Shops Cut Down Callbacks 27
How Detroit Increased Space-Heating Capacity to Supply 100,000 New Customers, *by Charles L. Ruff* 28
Peoples Gas Dedicates Big Chicago Exhibit 33
Tapered Port Pipe Burners, *by Burnie Porter* and *Willard M. Dow* 34
Test Meter Method, *by R. Frank Nowlin* 37
Overcoming Venting and Air Supply Problems, Part II, *by Keith T. Davis* 40
Performance Tests on Oil Contact Gas Scrubbers—Part II, *by P. W. McDonald* and *E. M. Woods* 48
Planning A Corrosion Control Program: Part II—A Symposium 75
Pipeline Section 87
How El Paso Lowers-In When Using Slack Loops, *by T. B. LaRock* 89
Centrifugal Compressor Stations Prove Efficient, Economical, Dependable, *by E. A. Koenig* 94
Imported Natural Gas for Northwest "Probable"—Manning 98
For Auxiliary Booster Station Power: Natural Gas Engines, *by Charles B. Briley* 100
Pipeline News 104

DEPARTMENTS

Associations 56
Calendar 61
New Products 62
News 66
Current Reading 80
People 82

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Highlights

GAS AND KOREA. Although as confused as anyone about what tomorrow holds, the industry is beginning to make decisions. It has wisely decided to proceed with the GAMA show in Atlantic City next month and the Old Stove Round Up, but commercial cooking manufacturers, facing steel shortages, have ditched "Proof of Profits" campaign for now in favor of a "service program" dubbed "Keep 'em Cooking." And . . .

GASMEN ARE TAKING STEPS FOR DEFENSE. A joint AGA-EEI committee is cogitating possible excess profits levies with an eye to advising Congress on utility problems; J. French Robinson, Cleveland, heads a new 12-man AGA group on national defense. First on the agenda is a study of steel needs. But . . .

CAST IRON PIPE PRIORITIES ARE BEING READIED. The 11-member Cast Iron Pressure Pipe Institute is establishing a system to give preference to military needs. Meanwhile . . .

FPC STUDIES GAS LINE NEEDS. Chairman Wallgren says steel availability for new lines is being surveyed. And . . .

W. PAUL JONES CITES GAS ROLE IN DEFENSE. Servel's head says by year's end gas will furnish 20% of nation's energy, is a strong asset for defense. On the local level . . .

UTILITIES DUST OFF EMERGENCY PLANS. Jersey Central (Asbury Park) and Philadelphia Electric announce establishment of security procedures.

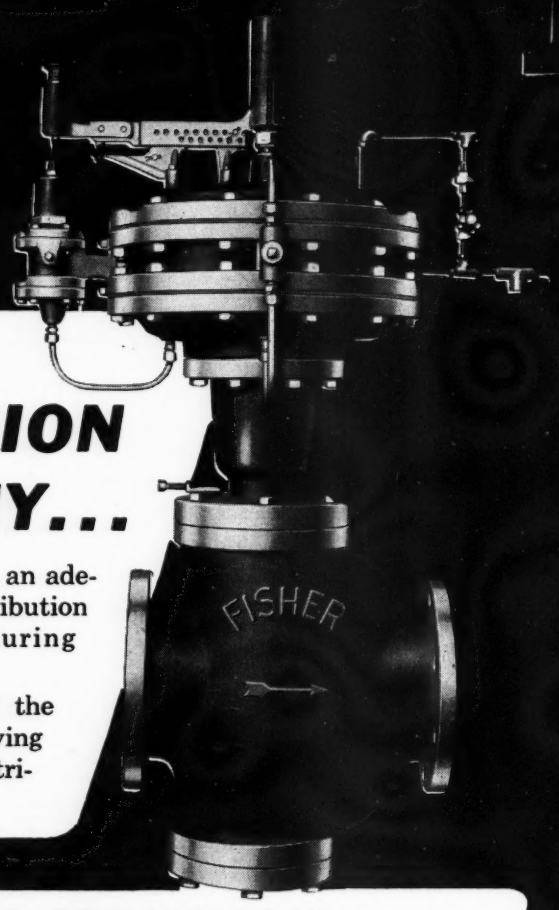
CONVERSION IN ROANOKE NEARS COMPLETION. Gas Construction and Service Co. expects to wind up the Virginia city's changeover —begun a month ago—in early September.

COMPETITIVE RESEARCH ON WATER HEATERS ON DECK. AGA's Hugh Cuthrell told PCGA conventioneers that gas and electric water heaters will be checked for performance, speed, delivery capacity, operating costs, to determine "proved equivalent" sizes of each type.

RECIPROCITY WITH CANADA? Mayor Reaume, Windsor, Ontario, is pushing a scheme to trade Alberta gas (for the Northwest) for Texas gas (for eastern Canada). He and Pacific Northwest Pipeline officials have had their heads together. (For more news on Northwest applications, see Association news and the Pipeline Section in this issue.)

TRANSCONTINENTAL vs. MILLTOWN. The Texas-to-New York line builders lost a round in their fight to assert eminent domain over the New Jersey hamlet, when a federal judge refused to grant a summary judgment restraining Milltown from interfering with pipe laying. The case will be heard further Sept. 14.

Fisher-King



for GAS DISTRIBUTION ECONOMY...

Fisher-King Booster automatically maintains an adequate delivery pressure throughout the distribution system by increasing delivery pressure during peak loads.

On more than 1000 installations throughout the country, FISHER-KING BOOSTERS are achieving outstanding economy in the control of gas distribution pressures.

FISHER-KING BOOSTER ADVANTAGES

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- **REDUCES SERVICE COSTS.** Many man hours, truck hours and mileage, formerly devoted to the attention of manually adjusted lever and weight regulators, are entirely eliminated. Fisher-King Boosters are completely automatic in operation and in adjusting for fluctuating demand loads.

- **ELIMINATES CONSUMER COMPLAINTS.** Since the Fisher-King Booster always provides adequate pressure in the distribution system, consumer complaints will drop sharply and customer good will is greatly improved.

WRITE TODAY FOR DETAILED INFORMATION

EDWARD TITUS

THERMALLY THINKING

Return to Common Sense

WHATEVER MAY BE THE TREND of world events in the months ahead, it is fortunate that industry and the public have recovered from the state of near-hysteria that prevailed in some segments in midsummer.

Most of the gas industry, to its credit, has been reasonably level-headed right along. To date registrations for the American Gas Assn. convention in Atlantic City have been coming in faster than in any previous year. There is a waiting list for space in the largest show ever to be put on there by GAMA.

After a week or two, the near-panic that prevailed in some quarters has faded in the realization that the capacity of American industry is so much greater than during the height of World War II that there will be facilities to produce both defense goods and consumer goods.

Capacity of important industries is 20 to 125% higher than 10 years ago.

Of course panic buying and hoarding all along the line have created certain artificial scarcities. With many consumers stocked up, however, the buying spree could run its course and the necessity for real selling could start sooner than you think.

It is therefore timely that Frank C. Smith, chairman of the general promotional planning committee of the AGA, expresses the hope that "our gas utilities will not pull the props out from under their local selling and advertising efforts or reduce their sales departments."

One estimate is that in the 12 months ahead military needs won't take more than 10% of national goods-and-services output, estimated to be $260 billion.

The other 90% will provide plenty of jobs and necessitate plenty of selling.

Tremendous Role of Gas

A DRAMATIC PROOF of the readiness of the gas industry to perform mammoth tasks in the current rearmament is the crossing of the Hudson to Manhattan Island of the line that will bring the first natural gas from Texas to the heart of the metropolis.

The industry is an immense peacetime industry. But in preparation for war and war itself, its role becomes of even greater importance. The new national defense committee of the industry therefore will have a real story to tell to the authorities in Washington on such matters as allocations.

According to W. Paul Jones, president of Servel, Inc., natural gas pipelines are currently carrying to industry and homes the energy equivalent of 80,000 hopper cars of coal weekly, or 40,000 more "carloads" of gas a week than in 1942.

Ten thousand tankers, of 100,000-bbl capacity each, would be needed to transport a volume of oil equal in energy value to the natural gas now being consumed annually. This is twice the number of tankers that would have been required for 1942.

Mr. Jones points out that the significance of these figures to America's new mobilization program is that natural gas can be counted upon heavily to ease the nation's transportation burden. Natural gas does not have to be transported by ship, rail, truck or plane.

No matter what degree of war preparation we are facing, the potential service of the gas industry to the effort will be very great.

But what about the additional gas needs of the two northern corners of the country, the Northwest and New England, whose industry is of great importance in industrial mobilization?

Whatever in the way of controls comes out of the present complicated situation in Washington, it is to be fervently hoped that nothing will interfere with quick availability of pipe and other materials to bring natural gas to points where it can directly serve industry—or indirectly aid the mobilization effort by releasing rail and vehicle transportation for other urgent needs.

FPC Move?

TALK OF POSSIBLE REMOVAL of the Federal Power Commission from Washington gets hotter and hotter.

The Modern Woodmen of the World have a very nice sanitarium in the foothills a few miles north of Colorado Springs, with engaging surroundings and a considerable group of buildings, if you include the bungalows of employees. Chairman Wallgren, from the state of Washington, presumably supported by Commissioners Draper of Wyoming and Wimberly of Oklahoma, is reported in favor of the Colorado Springs location. The Woodmen's sanitarium property is said to be for sale.

Removal looks so likely to some members of the FPC staff that they are reported to have taken options on attractive homes in the Woodmen area.

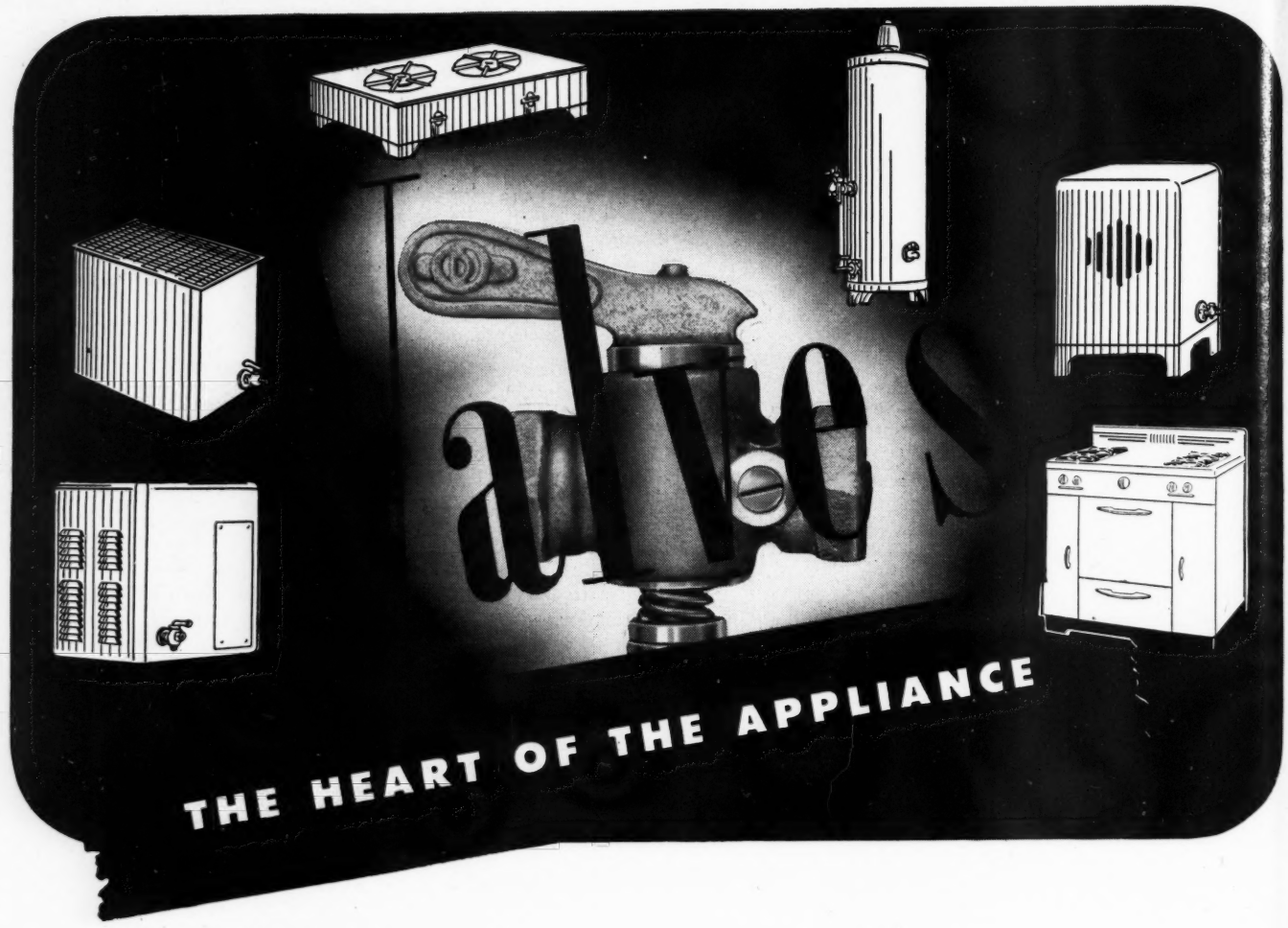
Unwise Tinkering

ELIMINATION OR REDUCTION of tariffs by reciprocal agreements with other countries is an idealistic sounding program. Those concerned with the subject, however, need to pay heed to the immediate practical effects.

When a program of this sort presents a threat to an entire industry that has existed in the United States for many years, and on which the livelihood of thousands of workers and their families depends, it becomes serious.

This is the problem faced by the meter industry. And the importance of the question was shown by the action of union leaders in wiring their senators and representatives.

It seems meters are involved with numerous other metal products in a broad-scale attempt to ease or eliminate tariffs among the Atlantic nations. The situation will come to a head with a meeting in England this fall. It would appear unwise to take action which would enable the American market to be invaded by meters produced by low-paid labor in other countries.



BE SURE THEY'RE THE BEST

Ultimate consumer reaction is influenced by valve efficiency and dependability. Materials, workmanship and engineering knowledge incorporated in the appliance demand valves of comparable calibre—valves that not only enjoy the long-standing recognition accorded to Detroit Brass products, but also valves backed by the assurance that they are designed to perform for the life of the appliance.

The fifty-year reputation of Detroit Brass for "quality-only" products is maintained in the company's ever-widening contribution to a great industry. The ready approval of the quality and service policy of Detroit Brass is attested to by the number of distinguished customers who for years have depended on this company as their main source of supply. Added to this are the expanded Detroit Brass facilities for the design, development and proving of special components—a service always available to you. That's why we say, when it's valves for gas—

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GUY CORFIELD

TECHNICAL TRENDS

A Whole Lot Of Hole

THE MIDYEAR REPORT ISSUE of the *Oil and Gas Journal* (July 27, 1950) gives some interesting statistics on the petroleum industry for the first half of 1950 and expresses some hopes and fears for the last half—hopes for even greater production and fears that the current international emergency will provoke hampering shortages and controls.

One of the most amazing of the statistics is that during the first half of 1950 there were 20,258 new wells drilled with a total depth of 74,816,000 ft. *This is 111 wells per day, or 408,831 ft per day*—truly a *whole lot of hole.* This drilling program and the concurrent crude production (over 5 million bbls per day) and related pipeline construction and refining and other operations are stated to be at the highest level in history.

The expectation for the last half of 1950, if conditions remain relatively normal, is even greater operations: 22,800 new wells to be drilled, and crude production of over 5½ million bbls daily. If heavy armament or war demands are superimposed on this, the activity may be still greater. Coupled with this outlook, however, is the rapidly rising spectre of critical material restrictions and shortages, and further plans—if not active steps—toward government control under the plea of national security and conservation of resources. The first thought is for steel, the importance of which to the petroleum industry is indicated by the statement that 2,842,200 short tons will be required annually merely to maintain drilling at the present rate and keep oil and gas producing facilities in repair. The fear is that there will not be realization, by those who may be placed in control in Washington, of the material requirements of the petroleum industry to maintain operations and to meet emergencies which may arise; or that materials may be diverted to the rapid development of plants to produce synthetic hydrocarbons from shale or coal to forestall a shortage of oil and gas which the petroleum industry insists will not materialize if it is left to work out its own problems with its own best judgment.

Natural gas, of course, goes hand in hand with oil drilling and production. On natural gas, the midyear report draws extensively from AGA statistics and current news with which the gas industry is familiar. It states that: "On the marketing side, natural gas continues in general to be favored by a relatively low and stable price. For many purposes, it is unquestionably a superior fuel, and the convenience factor weighs with residential users. On the other hand, the oil business will certainly resist further encroachment of its markets by gas... Despite problems of peak load, gas-reserve availability, and a government regulation that often is heavy handed, the natural gas industry continues to become an ever more important part of the nation's fuel economy."

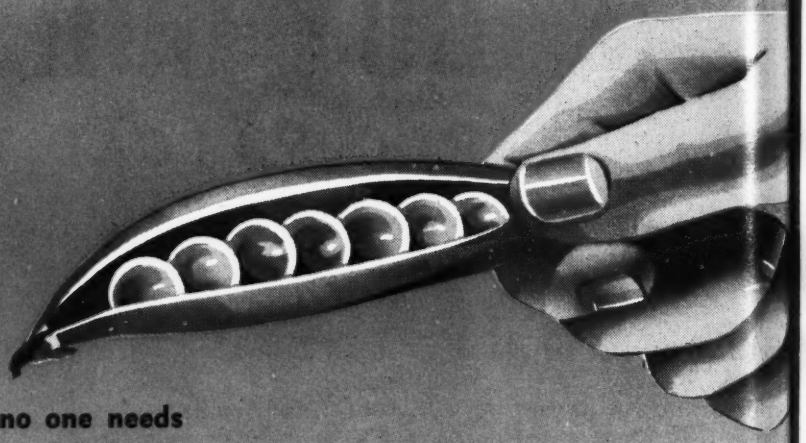
Flammability Of Gas-Air Mixtures

IT IS GENERALLY UNDERSTOOD that mixtures of air and a combustible gas are flammable, or capable of being ignited, only within a certain range or limits of mixture composition, the exact limits being a function of the combustible gas. The composition is expressed as the percent of gas in the gas-air mixture. The lower limit is the composition below which there is not enough gas in the mixture to sustain combustion; the upper limit is the composition above which there is not enough air to sustain combustion; the composition of the mixture at which combustion takes place most rapidly and completely is approximately that containing the gas and air in the theoretical ratio for complete chemical combination and, numerically, is approximately half way between the lower and upper limits. The exact limits for any combustible gas are to a small degree dependent on the size and shape of the container, whether the mixture is static or in motion with respect to the source of ignition, and the nature of the source of ignition (flame, friction spark, electric spark, etc.). For natural gas of the average composition distributed for fuel the limits of flammability are, in round figures, 5 to 15%.

It is not so generally realized that the above concepts and figures apply only at normal atmospheric pressure and that at higher pressures the limits become considerably wider. Some information on this has recently been published in the U.S. Bureau of Mines Report of Investigations 4457, "Effect of High Pressures on the Flammability of Natural Gas-Air-Nitrogen Mixtures." It is shown in this report that a natural gas-air mixture which has limits from 4.5 to 14.2% at atmospheric pressure will have limits of 4.48 to 27.7% at 200 psig, 4.45 to 44.2% at 500 psig and 4.0 to 52.9% at 1000 psig. Looking at this in one way, it is a little startling to note that natural gas-air mixtures at high pressures approach the flammability range of hydrogen-air mixtures at atmospheric pressure, which latter mixtures have always been regarded as the widest and most potentially hazardous, from an accidental ignition standpoint, of any combustible gas-air mixtures that the industry encounters.

This phenomenon of the widening of the limits of flammability of natural gas-air mixtures (and presumably it applies in general to all combustible gas-air mixtures) will assume greater significance as new processes and higher pressures are developed. It should be kept in mind in the mixed gas plants where the heating value of natural gas is lowered by admixture with air. In the oil and gas fields where repressuring is done with air or gas-air mixtures, because of lack of straight nautral gas, it assumes considerable importance. LPG-air mixtures, if highly compressed, should be given the same precautionary appraisal.

WARREN SERVICE . . . ALIKE AS PEAS IN A POD!



Anyone can supply LP-Gas when no one needs it! Warren's whole LP-Gas division is geared toward giving you better service when you DO need it. Warren PRODUCTION is going "great guns" during the months of low demand, to assure you ample supplies of Butane and Propane during YOUR PEAK SEASON. Warren's eight STORAGE terminals hold reserves in huge quantities for you. Warren's expanded TRANSPORTATION system is on the job all year through. Warren engineers and laboratories are ready to serve . . . . all tied in a sincere effort to keep Warren service, in all seasons, as alike as peas in a pod!

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STANLEY JENKS

PROMOTIONAL NOTES AND NOTIONS

Electric Pilot Lights

IT WILL BE VERY INTERESTING to note the gas industry's reaction to the newly announced gas range with two electric pilot lights, one for the top burners and the other for the oven.

It is an idea that has been batted around for years in gas industry circles, somewhat heatedly at times it must be admitted. Naturally, the "combination" companies are all for it. However, the idea has had adherents in the straight gas school, too, who have maintained that it has a definite operating advantage that cannot be ignored in the progressive development of our cooking load. They point to electric pilots on oil burners and electric controls on gas heating equipment, and claim it is foolish to deny the gas cooking customer a better gas range if the electric pilot will make it better.

On the other hand, its opponents contend that our present gas pilot works satisfactorily. It keeps the gas range "all-gas," and they talk of the dire consequences of electric service interruptions, heating coils burning out, and additional servicing expenses.

There is merit on both sides. Experience in the field will settle the argument.

Ride 'Em Cowboy

MY AGA SALES PROMOTION calendar reminds me that this month is the opening of the annual "Old Stove Roundup." Yippee! Hopalong rides again to corral every maverick old stove in sight, podner! Those in the TV areas can get all the rootin' tootin' inspirational ideas they want from the wealth of western movies served daily during the so-called Children's (that's a laugh) Evening hour. As a TV expert on Westerns: Hollywood, of course, we believe you—you *need* guitar-strumming virtuosos whose inherent love of home and mother do them credit, and plenty of shooting at the slightest provocation, either defensively or offensively. In our roundup, we'll be tracking the villainous obsoletes to their hide-out shack, and ending once and for all their daily dastardliness at the expense of their housewife victims.

Seriously though, the Old Stove Roundup is a proved success wherever it is staged enthusiastically and intelligently. It has every element of public appeal, showmanship, and the proper promotion that is required to achieve one of our industry's fundamental objectives: the modernization of our cooking load to insure its continuity in the face of competition.

The Heating Harvest

THIS IS THE MONTH, too, when we should be able to measure the results of the AGA national home-heating promotional advertising run in July and August, with local tie-ins. Whether we are going to cash in is a question that can be answered only at the local level.

However, the trend to gas central heating in the home is self-evident as the figures become available. The anthracite industry, realistically facing the facts of life, has appropriated $3 million as a promotional fund to stay the tide against it in the fuel field. In 1938, its output was 45.5 million tons. In 1944, it hit a peak of 62 million tons. Last year, its output was 41,880,000 tons. Even in the northeastern section of the U.S., which, at one time, was anthracite's happy hunting ground, it is estimated that only 45% of the homes now use anthracite. More ominous still for the anthracite boys is their own estimate that in only around 15% of the new homes under construction is anthracite heating equipment being installed.

The national shipments of gas-fired central heating equipment released by GAMA for the first five months of 1950 must be bringing no cheer to either the anthracite or oil lads. The gas-fired units were 307,400, an increase of 164.5% over the same period last year.

Oil burner installations increased, too. For the first five months of this year, they amounted to 203,900 units, compared with 141,689 last year—an increase of 44%.

And so the battle of the fuels goes. As our pipelines push farther and farther eastward and northward into the manufactured gas areas, up will go our sales. . . If we stick to our guns, and "let nothing us dismay. . ."

Political Ownership

AS AN ENGLISHMAN put it to me in London last year, the only thing wrong with Socialism is that it won't work. And the primary reason it won't work is that, human nature being what it is, political management of nationalized industries fosters ineptitude, waste, and inefficiency by killing all incentive for betterment.

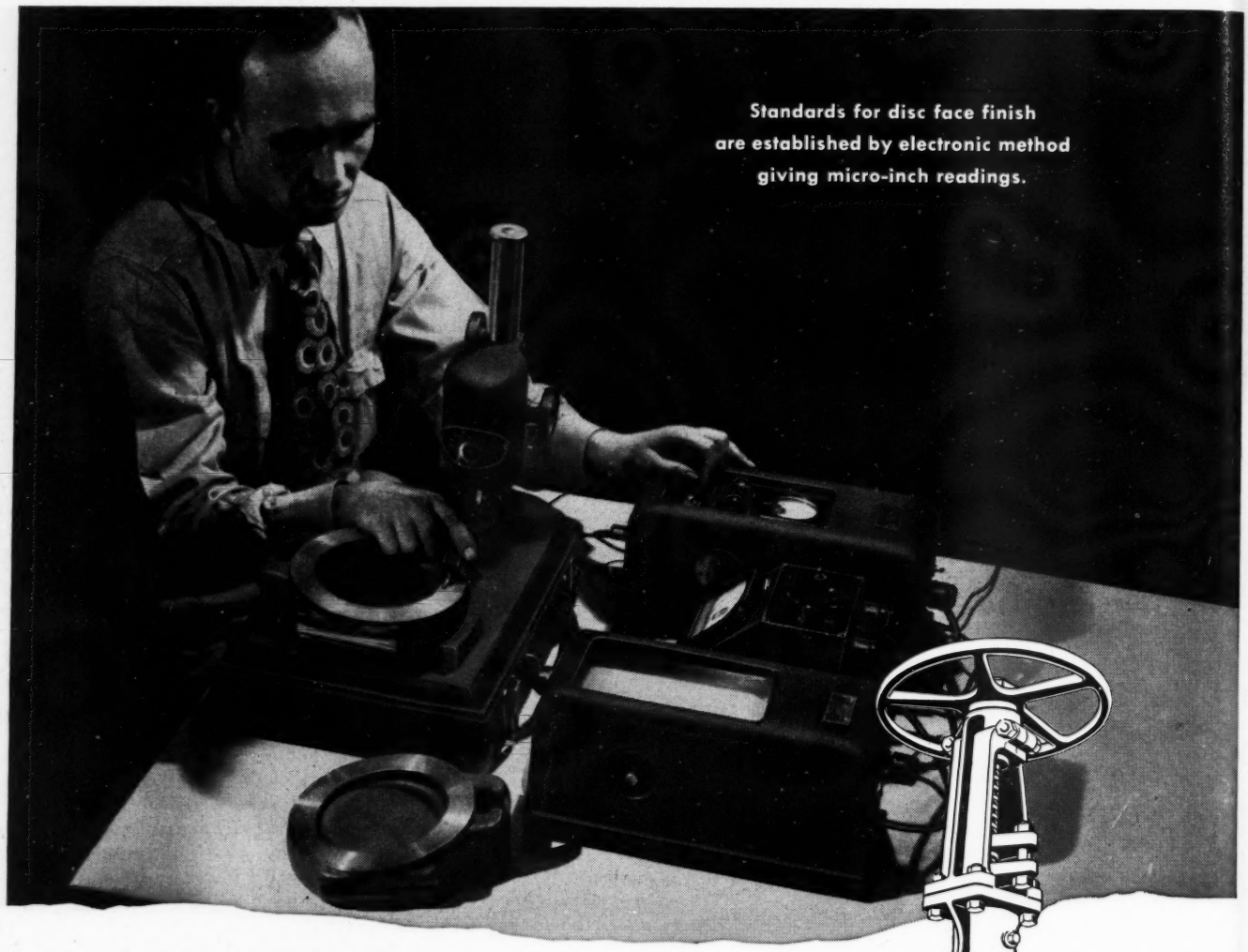
We have enough warnings about the dire consequences of political ownership in the public utility industry to emphasize how totally contrary it is in practice to the real public welfare.

A municipally owned water works, where graft and corruption have recently been exposed, prompted the local newspaper to editorialize in this view:

> It is very difficult to operate the many activities of the City Government as private business conducted for profit would be conducted. This is partly because there is little incentive for the taxpayers' representatives to save money; partly because much of the management is in the hands of persons who have little or no knowledge of business, and partly because of the type of help politics compels them to employ.

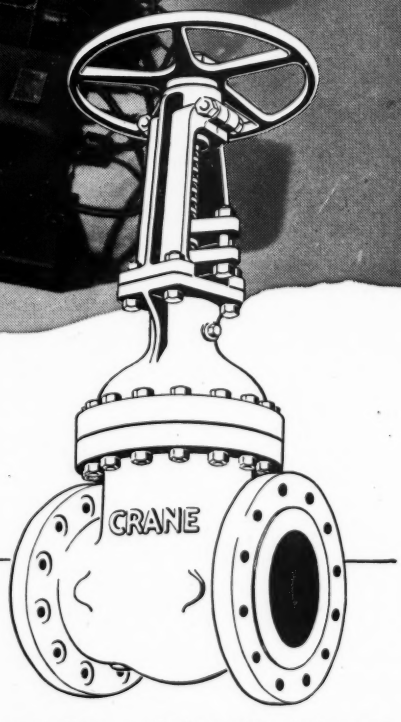
And still the economic planners (New Deal mumbo-jumbo for "Socialist") want our scalps. Why?

More **CRANE VALVES** are used than any other make



How CRANE controls quality to the Micro-Inch to cut your valve costs

Surface finish of a valve's working parts has a lot to do with its wear resistance and operating efficiency. A correct finish means a tighter-seating valve, easier operation, greater ease of maintenance. In Crane Quality valves, the surface finish of machined parts is measured and controlled to rigid limits. The standards for quality control of surface finish are determined by the most scientific methods as shown above. Yes, nothing is overlooked to make Crane Valves the lowest-cost valves in the long run. *That's Crane Quality!*



Precise quality control of materials, design, and manufacturing—to the highest degree in the industry—makes Crane valves the lowest cost valves in the long run. On steam service, oil and oil vapor lines, for example, you'll find Crane Steel Gate Valves a sure remedy for high maintenance costs. Talk it over with your Crane Representative.

CRANE VALVES

CRANE CO., *General Offices:* 836 S. Michigan Ave., Chicago 5, Ill.
Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING

EYE-STOPPING signboard sold gas for househeating to Minneapolis residents.

How Minneapolis Boosted Gas Sales Seven-Fold

BY HARRY K. WRENCH

WHEN it became evident in 1935 that Minneapolis would get natural gas, company officials of of the Minneapolis Gas Co. (then the Minneapolis Gas Light Co.) and the city attorney resolved to work out agreements that would benefit consumers through cost reductions and insure the company a fair return and an incentive for better service.

Such an agreement was necessary; prior to 1936, the company and the city had had a history of wrangling and lawsuits over the selling price of gas. Minnesota has no public service commission and rates are determined under the city of Minneapolis home rule charter. The company was at that time serving 550-Btu carbureted water gas under a 20-year city franchise.

Minneapolis' first rate agreement, which ran from 1935 to 1945, came out of the agreement that was reached. Under its provisions, the company was allowed to earn $1.25 million annually, plus 6½% on all net additions after June 1935, $225,000 for depreciation, and 2% depreciation on all net additions after June 1935. The allowed earnings were before fixed charges (bond interest and preferred stock dividends) but included all operations expenses of taxes and government impositions. Rates were determined quarterly under the plan; *Chart 1* shows that rates for gas during the early stages of the agreement were 14½ cents per therm, and that gross revenue in dollars and rate reductions increased and decreased, respectively, in the next 14 years.

The rise in gross revenues and the reductions in rates during the succeeding 14 years are best explained by dividing the period into three categories: 1935-40; 1941-45; 1946-50.

In 1935, when Minneapolis Gas changed over to 800-Btu Texas natural gas, the company was purchasing gas from Northern Natural Gas Co. on a demand-type rate, averaging 28 cents per Mcf. Minneapolis was also allowed to purchase gas over and above the demand being paid for gas — this was known as "put gas" — at 35 cents per Mcf. These rates were for gas of 1000-Btu heating value.

Harry K. Wrench
President, Minneapolis Gas Co.

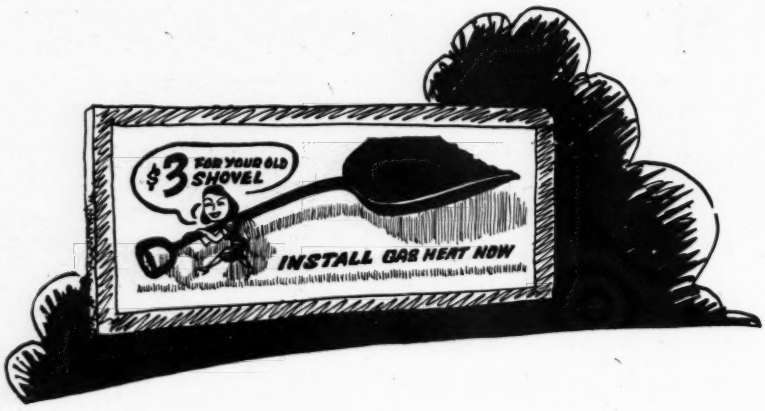
At the time of the changeover, Minneapolis Gas was serving 1153 househeating customers under a househeating rate of 72 cents per Mcf or 9 cents per therm. We were interested in increasing our load immediately, and, since Minneapolis has a degree day deficiency of 9418 degree days per year (based on 70°) it was readily apparent that our best opportunity for increasing our load lay in househeating sales.

Under the separate rate we installed for househeating gas only—66 cents per Mcf—we calculated that each customer, using 200 Mcf of gas annually, would bring us a gross revenue of $132 per year per heating customer.

We set up a househeating department immediately, headed by Ed Swanson, and operating directly under the sales manager. Early in the same year, we reorganized our heating department from a staff of five men to include a manager, who was a heating engineer, six supervisors (engineers or others with heating experience), about 30 salesmen (at least five to each supervisor), and a crew of clerks and junior engineers. A sales training program was carried on with vigor throughout the year, and was aimed at preparation for our all-year heating sales campaign—the effort, then a new idea, of selling heating equipment throughout the year instead of concentrating sales effort in the late summer and fall.

The 12-month househeating campaigns, conducted in the years 1935-40,

This paper was adapted from Mr. Wrench's address at the 1950 PCGA convention, Seattle, Aug. 1-4.



MINNEAPOLIS GAS went into the market for shovels with this signboard as part of big househeating campaign.

were real successes, and we believe the excellent results were achieved because each campaign was carried out through different emphases on the same, oft-repeated theme: Now is the time to switch to gas heating. In January and February of the year, we conducted the Sick Furnace campaign, directed toward the elimination of those warm-air furnaces with poorly designed or damaged or deteriorated ductwork. "Fifteen thousand are sick and need doctors" was the Minneapolis Gas slogan, and we backed up our advertising program with a system of coupons that allowed customers free inspection of their furnaces by a cooperating distributor.

In March and April, when Minneapolis weather fluctuates between cold evenings and hot days, the company decided that it would be a good time to demonstrate the flexibility of gas heat. This demonstration took the form of the Spring Try-out campaign, in which we sold conversion burners to customers for a $5 down-payment and no more payments until the next autumn.

The summer months were taken up with the Ask Your Neighbor About Gas Heat phase of the all-year program. We offered $5 (which would serve as a conversion burner down-payment) to customers who tipped us off to prospective heating customers.

Shovels for Sale

Minneapolis Gas offered "$3 for Your Old Shovel" during September and October, and pinpointed its advertising on the theme that the days of shoveling coal into the bin were numbered. The token amount was given to customers for old coal scoops, which were displayed in front of the company office—and made an effective display.

Employees entered the prize-competition for bringing in new heating customers during the Change To Gas Heat effort which was pushed during November and December. Employees wore buttons proclaiming the campaign, and advertising was closely tied in.

During the entire year's sales program, an integrated, hard-hitting advertising support was given through newspaper ads, billboards, movie trailers, and direct mail. Promotional contests, buttons, and competitions were used wherever possible. Employees could win anything from cash to suits of clothes, and tips were given to employees and to customers who gave us names of prospects.

By 1940, having repeated the all-year campaigns, with variations, in the interim, we could see that desired results had been achieved. The trend in Minneapolis was visibly to gas heat, and dealers were forsaking coal and oil furnaces to push gas equipment. During the period of aggressive selling by the company, we had added 12,175 househeating customers (see *Chart 2)*, the selling price of househeating gas had dropped from 72 cents per M to 62 cents, and general rates had dipped from an average 14.5 cents per therm to between 10 and 11 cents per therm. We discontinued company sales of heating equipment in 1940 and turned the job over to the dealers.

Dealers in househeating equipment are now 50 strong in the Minneapolis area, but in 1935-36, when we started to boost gas househeating, there was only one dealer (and the gas company) engaged in selling gas furnaces and other equipment. The war period, especially 1941-43, was of course a wet blanket on most househeating expansion, and our lack of growth in househeating sales in this period was notable.

Gas househeating in Minneapolis really came into its own in the postwar years, however. Oil and coal prices were rising steadily, and we had an unrestricted supply of gas at 18 cents per Mcf (average consumption) from Northern Natural. Beyond this average consumption, which was based on the three low summer months' average consumption, gas was available to Minneapolis Gas at 28 cents per Mcf. It soon became apparent from the customer demands for gas heat that our supplier would be unable to meet demands of the first cold days, unless restrictions were imposed. FPC, seeing that Northern Natural would be unable to meet the demands of customers under unrestricted sales, issued an order prohibiting the taking of new househeating customers in 1947. Installations already underway were allowed, however, so we added 9418 customers in 1947.

In the period 1947-50 we have gradually added new heating customers—in conversions and new homes—until we have a present total of 70,189 customers. And we still have a backlog of 12,000 conversion applications and 5000 new home gas heating requests.

During the time that Minneapolis Gas was hard at work in load-building through gas househeating promotion, the sales of other gas users were running like this: 13,790 gas ranges were sold in 1935-40 as opposed to 9724 electric ranges; and 6120 automatic gas water heaters were sold as against 5163 electric. These sales were made in Minneapolis proper, and do not include figures for the suburban area.

A Postwar Plan

Early in 1944, we believed that the time was at hand to determine what our various policies and programs were to be immediately following the U. S. return to a peacetime economy. We engaged the Northwest Marketing Survey Co. for a city-wide survey that was to tell us: The trend in customer acceptance of various fuels for the Big Five household jobs; what our policy should be in regard to postwar extension of mains; the public relations position of our company with respect to other city utilities and how we could improve it; and the type of household equipment that would be in demand after the war.

From the survey, we learned of several conditions that needed immediate improvement: Many customers were anxious to change from old "side-arm" water heaters to automatic ones; little interest in gas refrigeration showed that this field needed heavy selling effort; a large percentage of customers was anxious to install gas heating at war's end. On the good side of the ledger was the fact that the survey revealed general satisfaction with current gas service.

But the results of the survey as pertaining to gas cooking provided the major shocker. Researchers learned that more than 33% of those queried said that they would change from gas to electric cooking at war's end! The reason given was almost unvarying: gas wasn't as clean for cooking as electricity. When we learned of this attitude, we quickly

called a conference with our advertising agency and set about mapping a program to dispel this misconception.

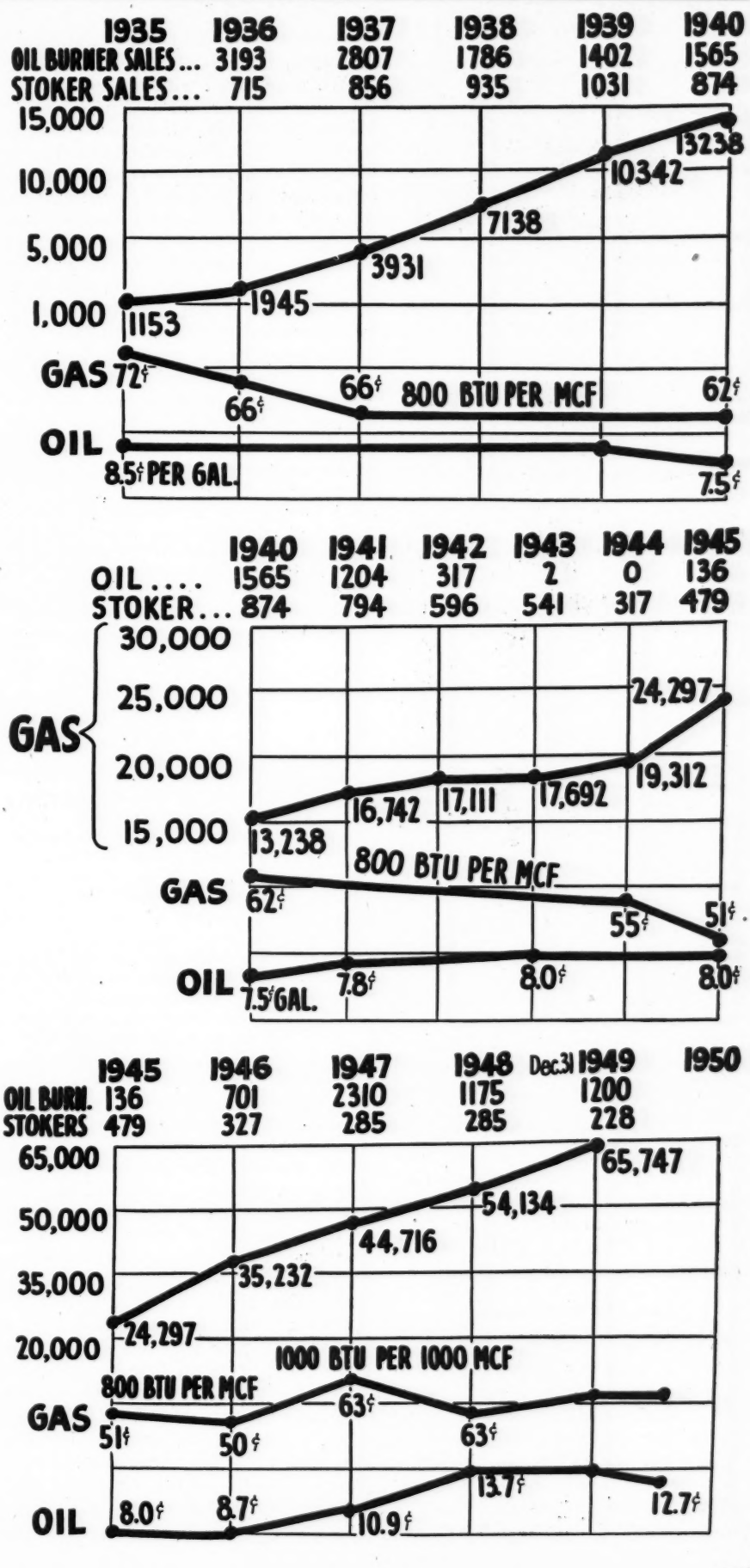
"Cleanliness is Natural" was the theme of this campaign, which had as its objective the proof to housewives that, indeed, there is no cleaner cooking fuel than natural gas. The advertising employed is illustrated on these pages. The program was carried on on an intensive scale for 15 months, at the end of which time we again used the Northwest Marketing Survey Co. to check results. Here are the opinions gathered by the survey group:

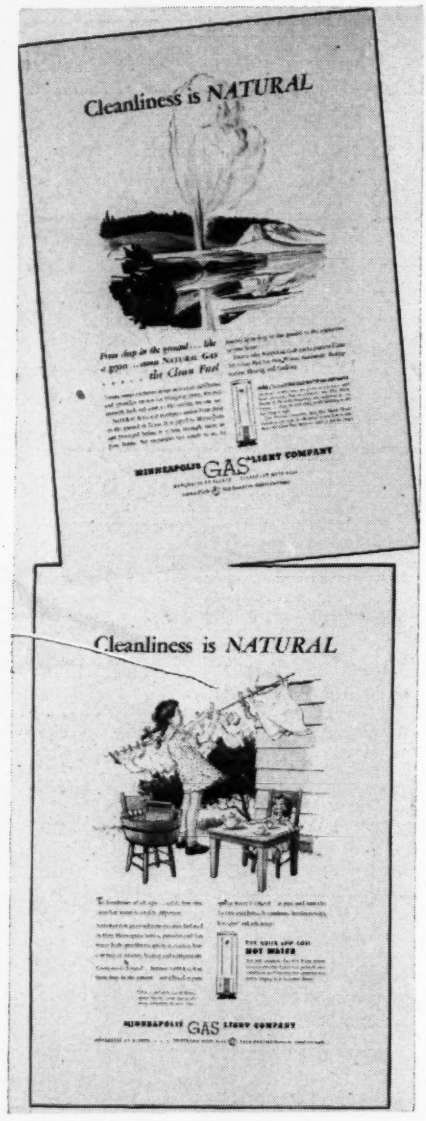
1. Natural gas is cleaner than the old manufactured gas — pots and pans and other household equipment stays cleaner.
2. "Cleanliness is Natural" is a gas company slogan (53% recognized it as such) and the city-wide trend is to natural gas.
3. "Cleaner" is a good slogan — it is associated with cooking and housework.
4. A blue flame means that a range is properly adjusted.
5. Gas range speed and easy control make it best for cooking.
6. The gas company is doing everything it can to better its service.

All during the period 1935-45, Minneapolis Gas Co. had been stepping up its gratuitous services in the form of work on customers' premises. For such work, the company had been spending about $100,000 annually in the years before; this amount had increased to $200,000 by 1940. At that time, our rate agreement had been in operation five years and had five more to run. It had proved so satisfactory to company, city, and customers that we applied for and were granted a new 20-year franchise and rate agreement which allowed the company to sell straight natural gas to industrial customers. Provision was also made for eventual changeover of the entire system to straight natural. This finally came about in December of 1947, when, after preliminary conversions and authorizations, we switched to straight, 1000-Btu natural gas. Cost was originally $1.00 for the first 300 cu ft or less; $1.75 per Mcf for the next 1700 cu ft; $.63 per Mcf for the next 28 Mcf; and $.56 per Mcf for the next 130 Mcf. (This has since been reduced in both steps and cost until at present the rate is $1.00 for the first 300 cu ft or less; $.63 per Mcf for the next 29.7 Mcf; and $.56 per Mcf for the next 130 Mcf.)

At the same time, our industrial department, which had consisted of Bert Roberts, its head, and one engineer, was expanded to include three more industrial engineers. In the summer of 1940, we started intensive work to increase off-peak business from the industrial load. In that year, interruptible load of 398.6 MMcf was sold at an average rate of 25.78 cents per Mcf, and firm industrial load of 250.9 MMcf was sold at an average of 76.67 cents per Mcf. Total

Three Phases in Minneapolis' Househeating Growth





CLEANLINESS IS NATURAL ad series righted misconceptions that gas is a dirty fuel.

revenue from industrial load was $295,159 for 649.5 MMcf of 1000-Btu gas. This compares with 1949 sales of 9.898 billion cu ft of interruptible gas at 19.54 cents per Mcf, plus 1.176 billion cu ft of firm industrial gas at 50.91 cents per Mcf; total gross revenue: $2,532,897! In 1940, industrial business in volume was now four times as great as *all gas sold* when mixed gas was first introduced in 1936! This was accomplished with an expenditure of just more than $2 million in new construction during the five-year period. During those five years, our net earnings before fixed charges rose from $1.2 million to $1.5 million.

The Postwar Period

At war's end, with our rates at 50 cents or 6 cents per therm for house-heating gas, and with costs of other fuels rising sharply, it seemed to us that the time had come to cash in on our steadily decreasing rates, our good service, and the groundwork of our earlier aggressive selling campaigns. We started the "cashing in" with a booklet, "See How Much You Save," published in 1946.

We were faced with a complete rebuilding of our sales department—which section was almost non-existent during the war. Discussion and consultation brought us to the conclusion that this could best be done by organization of a Minneapolis Dealer Plan—and not by operating a large sales force of our own. In preparing to launch such a program with the 350 appliance dealers, we realized that intensive research would be necessary to investigate each dealer's position to determine his operating and sales problems, and an orientation program to show him what the utility could do to boost his profit totals.

To approach our goal, we followed these steps:

1. A program was set up to train dealer-contact men in training dealer-salesmen, organizing dealer advertising, and helping with dealer accounting.
2. A clinical record was developed to analyze the strong and weak points of each dealer's operation. This developed a pattern of procedure for our program.
3. The records gathered in (2) were used to set up four classifications or divisions wherein the company could best help the dealer and increase the profit in his operation:
   a. Good housekeeping: timely displays, sales records, general store appearance, and adequate inventory.
   b. Sales training: hiring new salesmen, proper training, house-to-house selling, developing prospects, planning.
   c. Advertising: newspaper, radio, television, billboards, carcards.
   d. Promotions: cooking schools, anniversary sales, home shows, special events.
4. A sales control record was set up for each dealer—and the dealer-contact man kept his eye on them closely. If sales fell off, the sales control record ("management's radar") told the contact man why, and he could show the dealer what to do about it.

The success of this dealer program since its inception just after the war is easily testified. The progress in dealer appliance sales since 1946 has been extraordinary: in 1946, 3531 gas ranges were sold and 1768 water heaters were purchased; in 1949, the totals for these two appliances were 11,731 and 11,485.

In Minneapolis, a city ordinance requires a permit for each change of a major appliance within a home. This permit requirement, together with the records of permits, has made an authoritative source of information. For instance, we have records of all electric appliances that have been in use for 10 years or more. To the owners of such appliances we send a direct-mail piece advising replacement with new gas appliances. This simple plan has proved successful.

These records have also furnished other evidence of the success of Minneapolis dealers. Records for 1949 show that dealers *removed* 118 more electric water heaters than were sold. The ratio of gas to electric range sales last year was *52 to 1*, as compared with the national ratio of 1½ to 1. This year—up to May—the ratio in Minneapolis is 77 to 1, and 67 more electric water heaters were removed than were sold. It is interesting to note that in order to get complete dealer cooperation through its program, Minneapolis Gas did not find it necessary to subsidize the dealers in any way.

Another postwar department that has proved very worthwhile has been our Kitchen Planning department, which, operating under the guidance of Robert Calrow, received 3243 requests for help last year. This activity provides excellent opportunity to tell homemakers the story of gas, to show them modern gas appliances in operation, and to show them the way to easier housekeeping. This department has also helped increase the number of dealers in Minneapolis who sell complete kitchen units.

With the postwar development of the Kitchen Planning department in Minneapolis Gas Co., the Home Service department was also strengthened.

The Hotel and Restaurant department has been most successful in its job, which began with its organization in 1930. The big job in those days was to outsell coal and oil as heavy-cooking fuels. This was done so successfully that we were able to discontinue utility sales of commercial cooking equipment in 1938, when we also ended our direct-mail advertising program to hotels and restaurants. We still distribute "Cooking for Profit" magazine to 2300 of the larger restaurants.

More than 99% of the hotels and restaurants in Minneapolis now use gas for cooking—and the only exceptions are two national, chain organizations who purchase equipment elsewhere.

Conclusion

Today, Minneapolis Gas Co. is furnished 107 MMcf of gas daily by Northern Natural Gas Co., which amount will be increased to 135 MMcf next winter. An additional 50 MMcf per day will still be needed to take care of potential demands. We hope that this extra daily amount will be forthcoming by 1953. Since the war, excluding 1950, we have spent $9 million in net additions—this year's budget approximates $3.5 million.

Our gas sales will exceed 30 billion cu ft this year, and our net for common stock, before fixed charges, will exceed $2 million.

Service Shops Cut Down Callbacks

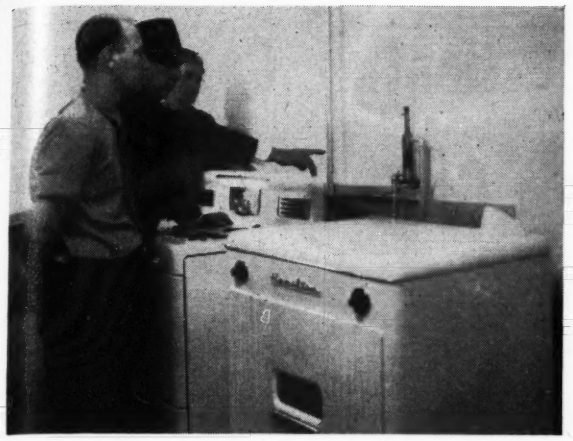
SHOPS for testing and adjusting of new appliances before installation in a customer's home, recently established in all eight districts of the Pittsburgh Group of the Columbia Gas System, are eliminating 50% of service callbacks, cutting installation time from two or three hours to 30 to 45 minutes, and making the companies' customers a lot happier.

Now when a range, for instance, is delivered to the buyer's home, it is in top shape for a quick connection, all evidence of possible shipment damages having been removed, and all working parts having been checked to assure performance as specified.

Set up under the direction of William J. Kretzler, general service manager for the group companies, the shops are equipped to handle ranges, refrigerators, and gas-fired clothes dryers. Equipment has been standardized. An ample supply of spare parts has been stocked. Generous storage space is available for merchandise not needed for immediate delivery.

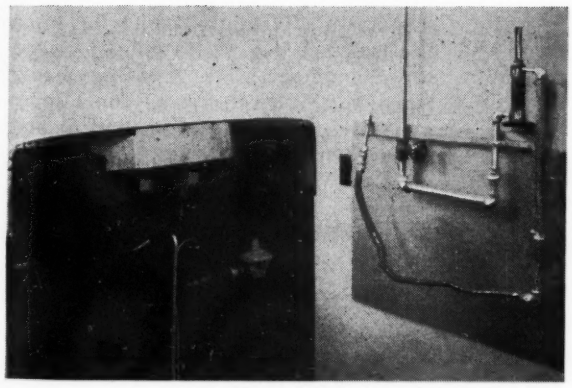
When merchandise is received, it is first checked for damage in transit, then stored for future servicing. In the checkup, complete inspection is made for damaged or improperly functioning parts. Burners and controls are adjusted and set, a test is made with an Emco 2 flow indicating meter, and finally, the appliance is carefully cleaned.

Courtesy *News & Views*, employee publication of the Pittsburgh Group, Columbia Gas System.



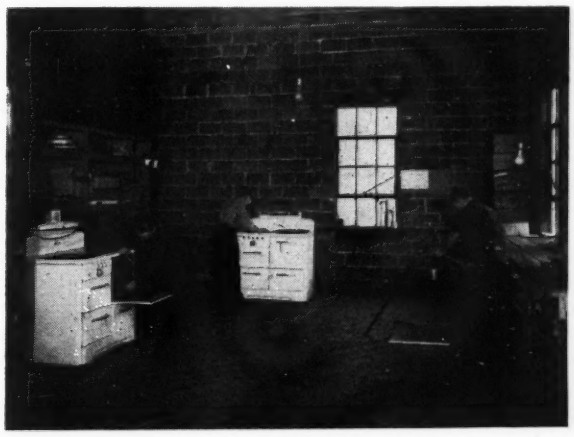
METER CHECK during appliance testing in Pittsburgh Group operation is explained to customers servicemen by W. J. Kretzler, general service superintendent.

STORAGE BINS of appliance parts and other equipment make repair of shipment damaged appliances easy. At right, worker checks range's drawer for alignment.



IN TESTING, flow indicating meter at right is connected to pipe that feeds range burners. Control of gas flow, filters that clean inlet pipes insure laboratory conditions.

THREE PHASES of work to make ranges ready for delivery to customers are shown at right, above. One service man aligns oven door; another (background) adjusts burners; another (right) threads connection nipples.



TOUCHING UP appliance paint jobs that have suffered from shipment is a regular part of the job, shown at right. A 24-lb pressure compressor operates spraygun.

How Detroit Increased Space-Heating Capacity To Supply 100,000 New Customers

By Charles L. Ruff

EARLY in 1949 progress on the Michigan Wisconsin Pipe Line Co.'s construction program had reached a point that encouraged hopes for a completion far ahead of schedule, tentatively set for Jan. 1, 1950. Presuming that the line would be completed sufficiently ahead of schedule to justify a mid-year lifting of restrictions on the use of gas for spaceheating, it was obvious that some projected thinking was in order to determine what problems would be encountered in the way of new construction, reinforcing, or changes in the distribution system necessary to meet the anticipated increase in spaceheating units for domestic, commercial, and industrial use.

At that time our distribution system was mainly designed for the distribution of gas at standard, or so-called low pressure of approximately 6-in. w.c. Realizing that the lifting of the restrictions on the use of gas for spaceheating might result in the development of a load demand that would exceed the capacity of our present distribution system, we initiated studies for the purpose of collecting data that would point the way toward a reinforcing program that would (1) give a large and flexible potential capacity, (2) be the most economical to accomplish, (3) require the least amount of time to complete, (4) maintain a more uniform pressure to the meter, and (5) minimize public inconvenience.

These studies covered the problems and expense involved in the installation of additional header mains, larger lateral mains, and the installation of house regulators and conversion of the system to elevated pressures varying from ½ to 5 psi, depending on the load demand developed. It was apparent from these studies that the most economical method and, we believe, the most practical, would be the installation of house service regulators and the conversion of the distribution system to elevated pressures. This method would eliminate pressure variation at customers' appliances and would allow pressure drops from 1 to 1½ psi in the distribution system, greatly increasing the capacity of the system. It could also be started immediately and completed in time to handle the anticipated winter loads. With a system consisting of 12-in. headers spaced a half mile apart, supplying 4-in. laterals, and with the headers fed at mile intervals, capacities per square mile are as follows:

4-in. water pressure drop	240,000 cf/hr
16-in. water pressure drop	480,000 cf/hr
1 psi pressure drop	620,000 cf/hr

In Detroit the average square mile saturated contains approximately 4200 customers. The demand per househeating unit, with diversity average 100 cf/hr, allowing 20 cf/hr for gas usage other than househeating, would give a total demand of 120 cf/hr per customer for a completely saturated square mile, or a total demand of approximately 500,000 cf/hr. This condition probably will never be reached, but it shows that 1 psi pressure drop is sufficient to supply the requirements in a square mile, with an extra amount available for heating large apartment houses and also small commercial loads. The decision to convert the system to elevated pressures presented some additional problems for study:

1. The effect on appliance operation during the conversion period.
2. The type of regulator.
3. The manner of installing the regulator.

The tolerance range of utilization pressure was established through studies made in our training center and central laboratory on an appliances and house piping setup. It was obvious from these data that a range of pressures varying between 5-in. w. c. and 8-in. w. c. would provide a service to the customer resulting in a minimum of inconvenience, and hold the request for appliance adjustments to a low figure. This assumption held true during the conversion period.

The type of regulator suitable for a program of this nature was somewhat of an unknown factor, as the stock regulators used prior to the development of this program were basically designed to operate on inlet pressures far above the pressures available on the standard or low pressure distribution system of 6-in. w.c. Regulator manufacturers were consulted and their engineers joined us in the study of regulator performance and design and possible changes in their current stock regulators.

The study of regulator performance indicated a point of maximum flow within the tolerable range of pressures for satisfactory utilization and furnished the data to develop the regulator specifications shown in *Tables 1, 2,* and *3.* The test includes the performance of the regulator on elevated pressure with the adjustment unchanged from the original setting made by the manufacturer.

Tests were made to determine the venting effect under varying conditions, including the regulator vent opening, the vent pipe size and length, the value of the mercury relief and the internal mechanical relief against the no-relief type. It is obvious that we have somewhat overemphasized the protection furnished through the use of the mercury relief and the internal mechanical relief type regulators in the event of a diaphragm rupture. It is apparent that the no-relief regulator properly vented, will render approximately the same degree of protection.

A regulator package unit was made up in an assembly shop on a production line with a man-day production average of 100 daily, using the lathe illustrated in *Fig. 1.* Specifications for the component parts of the regulator package unit, exclusive of the nipple, are shown in *Figs. 2, 3, 4,* and *5.* The use of the regulator package unit result-

Mr. Ruff, service shop superintendent, Michigan Consolidated Gas Co., originally presented this paper before a meeting of the New England Gas Assn., Springfield, Mass., May 4.

Fig. 1. Lathe for assembling regulator package units.

Fig. 2. Standard conversion (service riser) from low pressure to medium pressure.

Fig. 3. Vent screen.

Fig. 4. 1¼-in. x 1-in. reducing nipple.

Fig. 5. 1¼-in. compression x 1-in. male reducer.

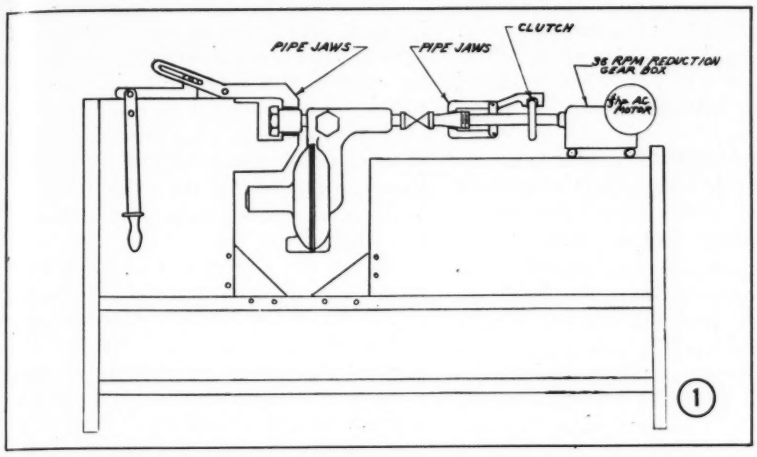
Fig. 6. Comparison of time required to install ¾-in. gas pressure regulators.

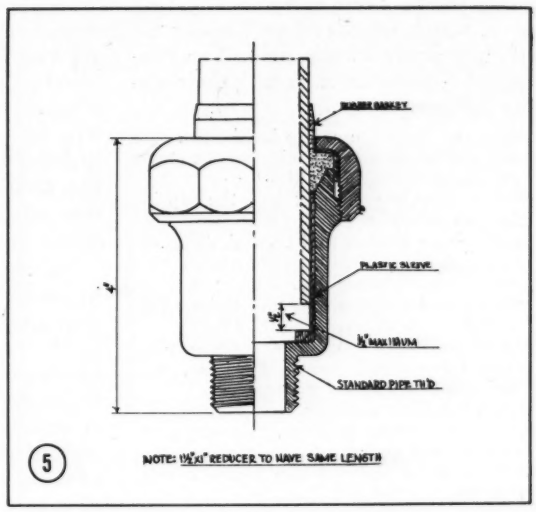
Fig. 7. Gas retention bag.

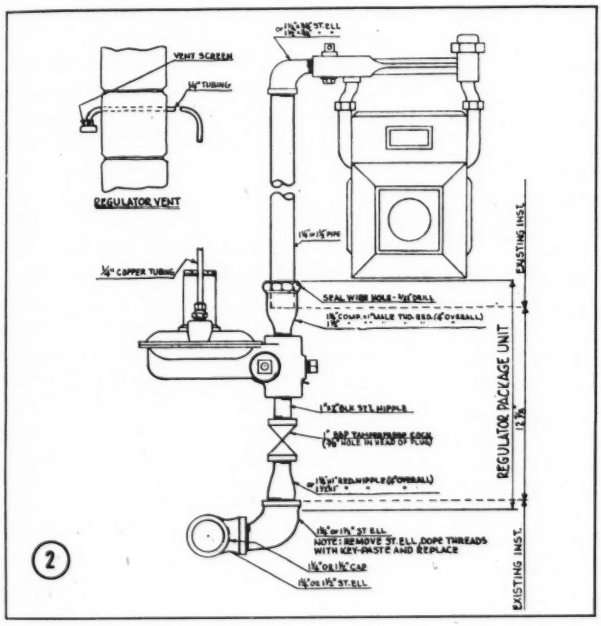
Fig. 8. Application of gas retention bag.

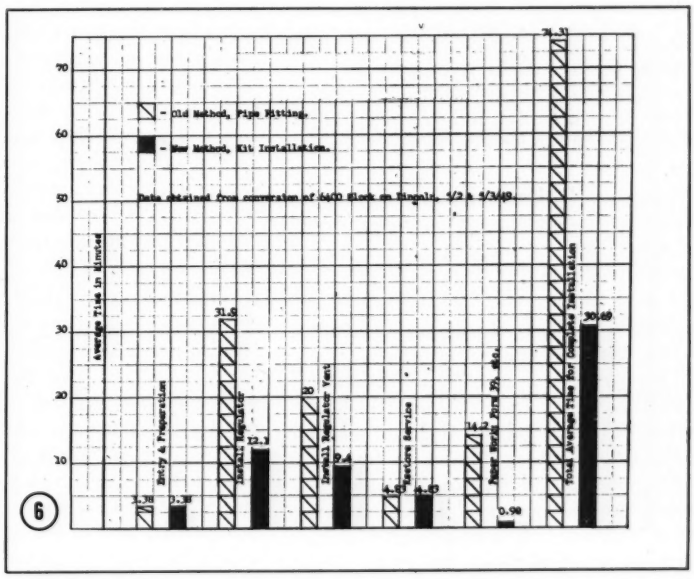
Step A: Loosen service cap to hand-tight with wrenches.

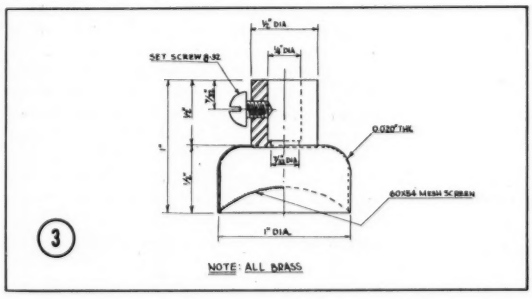
Step B: Install gas retention bag, containing safety test stopper, over service tee cap.

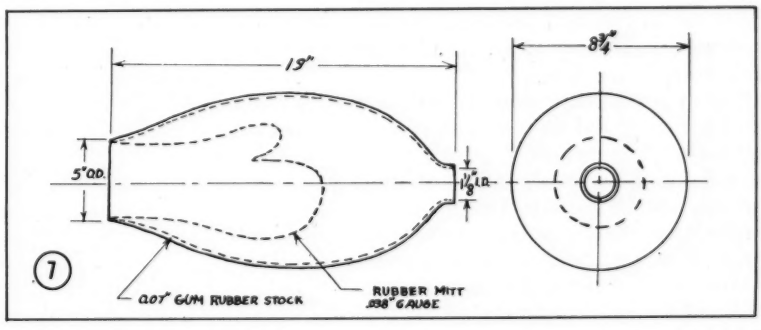

PIPE JAWS
PIPE JAWS
CLUTCH
36 RPM REDUCTION GEAR BOX
1/3 HP. AC MOTOR
1

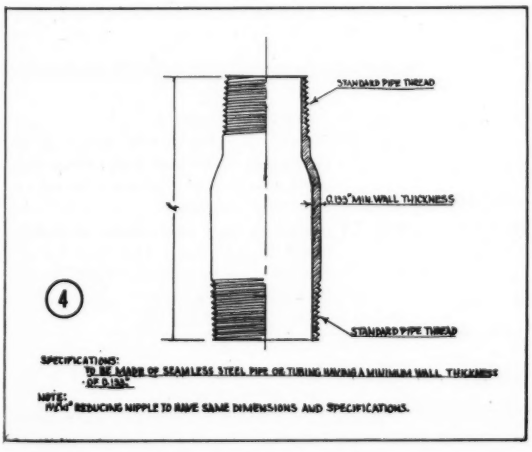

RUBBER GASKET
PLASTIC SLEEVE
1/4" MAXIMUM
STANDARD PIPE THD.
5
NOTE: 1 1/4" x 1" REDUCER TO HAVE SAME LENGTH

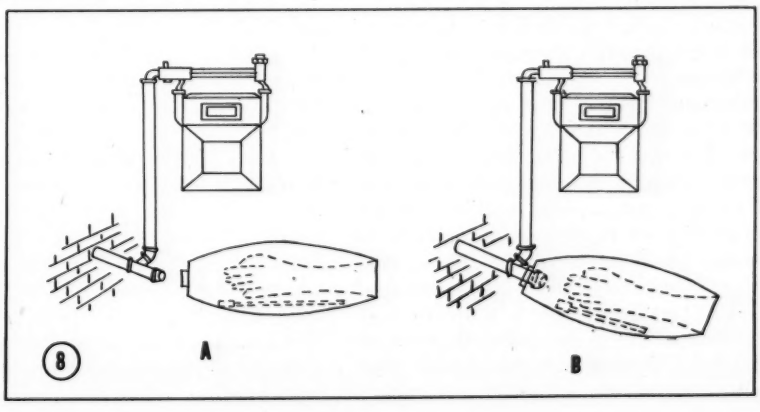

VENT SCREEN
1/4" TUBING
REGULATOR VENT
1/4" COPPER TUBING
SEAL WIRE HOLE - 1/16" DRILL
1" x 12" BLK. ST. NIPPLE
1" BAP TAPERED PLUG COCK (3/64" HOLE IN HEAD OF PLUG)
1" x 12" RED. NIPPLE (6" OVERALL)
1" OR 1 1/4" ST. ELL
NOTE: REMOVE ST. ELL, DOPE THREADS WITH KEY-PASTE AND REPLACE
1" OR 1 1/4" CAP
1" OR 1 1/4" ST. ELL
REGULATOR PACKAGE UNIT
EXISTING INST.
EXISTING INST.
2


Old Method, Pipe Fitting.
New Method, Kit Installation.
Data obtained from conversion of 44CD Block on Singalo, 5/2 & 5/3/49.
Average Time in Minutes
Duty & Preparation
Install Regulator
Install Regulator Vent
Restore Service
Total Average Time for Complete Installation
6


1/2" DIA
1/4" DIA
SET SCREW 8-32
0.020" THK.
60 X 64 MESH SCREEN
1" DIA.
NOTE: ALL BRASS
3


19"
8 3/4"
5" O.D.
1 1/8" I.D.
.020" GUM RUBBER STOCK
RUBBER MITT .038" GAUGE
7


STANDARD PIPE THREAD
0.133" MIN. WALL THICKNESS
STANDARD PIPE THREAD
4
SPECIFICATIONS:
TO BE MADE OF SEAMLESS STEEL PIPE OR TUBING HAVING A MINIMUM WALL THICKNESS OF 0.133"
NOTE:
"NEW" REDUCING NIPPLE TO HAVE SAME DIMENSIONS AND SPECIFICATIONS.


A
B
8

ed in a saving of time, as indicated on *Fig. 6*, which was developed under actual time study in the field. The procedure followed for installing the regulator follows:

Loosen the street tee cap to hand-tight.
Install gas retention bag, with service stopper inserted. *(Figs. 7* and *8.)*
Remove street tee cap and drop the cap in the gas retention bag.
Insert service stopper and expand. *(Figs. 9* and *10.)*
Remove gas retention bag.
Install pressure test nipple and tighten for pressure test. *(Figs. 11* and*12.)*
Measure and cut out a piece of the service riser, remove and re-dope street tee, and street ell, install and tighten.
Thread regulator package unit in street ell.
Tighten and swing in place, raise top part of riser, and meter.
Insert riser in compression adapter and tighten.
With the rigid cock in the off position and the service stopper in place and the service cock open, a pressure of 10 psi is developed through the use of a bicycle pump at the pressure test nipple and the fittings and regulator soap suds tested.

The procedure for removing the service stopper is the reverse of the installation.

On Aug. 1, 1949, when the restrictions were removed on the use of gas for spaceheating, we had 85,000 spaceheating units on our lines in the Detroit area and to date the installations have increased to 180,000 with an additional 25,000 applications on hand.

To meet this increased load demand it was necessary to install 86,500 house regulators during 1949 before the peak of the spaceheating season. A program of this nature and magnitude would obviously require special tooling and a great amount of manpower; consequently, studies were made to determine the proper tool requirements to expedite the installation program and the proper organization to accomplish an early completion date.

A program of this nature requires a lot of leg work and fatigue is an important factor; consequently, our thoughts were focused in the direction of light and easy-to-handle tools. This prompted the purchase of aluminum pipe wrenches in the 18-in. and 24-in. sizes and special electric motor drills with a smooth regular handle grip, making them easy and comfortable to lean against to develop pressure against the drill bit while drilling holes through masonry and brick buildings.

Portable electric generators were furnished in order to eliminate the time required to make a connection to the customer's electric current in the basement or living quarters, and to eliminate the possibility of customers' objection to the use of their electricity. These generators were mounted on hand carts and were moved from house to house by rolling the cart along the sidewalk. All vent holes were drilled from the outside after being marked by a layout man with a ⅜-in. fluted drill bit with a tungsten-carbide tip. This drill bit, shown in *Fig. 13*, can be used on masonry brick or wood when the wood is on the inside of a masonry or brick structure. On wood structures a ⅜-in. wood bit was used. As most of the pipe cutting was done on the vertical run and perfect alignment was essential, it was found that the 4-wheel pipe cutter was the answer.

As the operation of installing the house regulators involved the interruption and restoration of the gas service to the appliances, it was properly a function of the service shop department organization to make the installation. Normally you would not expect to find in any servicing organization a reserve of manpower available for the handling of a program of such magnitude. This problem suggested two methods of approach: to increase the service organization out of proportion to the anticipated future requirements, or to have some of the work done on a contract basis. The decision was made in favor of the latter, as increasing the service organization presented problems of disposing of the surplus manpower at the completion of the house regulator installation program.

The work was divided in two parts, gas handling and regulator and vent installation. A serviceman and a contractor's man made up the team, with the serviceman's responsibility consisting of the interruption and restoration of gas service to the appliances, and the contractor man's responsibility consisting of the installation of the house regulator and vent—each, of course, to be as much help as possible doing whatever was necessary to conserve time and complete the installation satisfactorily to all concerned.

A complete record of the completed regulator installation and the man hours spent was maintained. This record included the gas company personnel and the contractor's personnel. It was found that an overall average of five installations per man per day was maintained for the 86,500 installations. This agreed with the estimated figure of five installations per man per day calculated from the study made on manpower requirements. It is noteworthy to mention at this point that due to the manner of converting the districts, no official notice having been given to the customers, the number of CGI's approached 20,000. As a result, 22% additional calls had to be made before the complete conversion could be realized. It was also found that 17% or 15,000 were special installations requiring special fitting work where the packaged unit could not be used. Considering the large number of CGI's and special installations, the rate of five installations per man per day was very good.

After the conversion areas were designated, detail maps were assembled showing the areas where mains were to be capped and district governors installed or converted. Since the conversion area boundaries were designated where possible along natural separating lines the number of mains that had to be capped to isolate an area was reduced considerably.

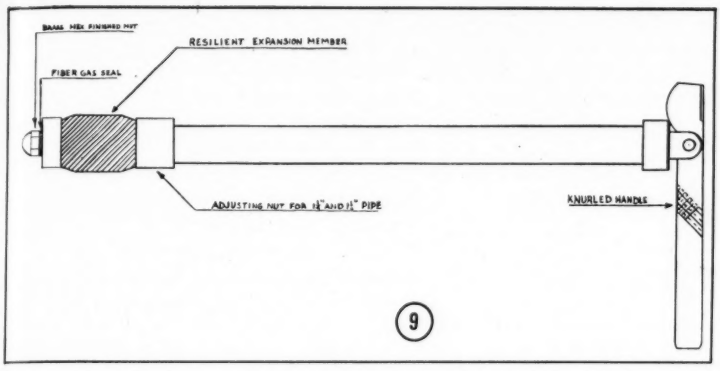
Before the conversion crews moved into an area, a leak survey of the mains and services was conducted by the main and service investigation division. The method of survey employed involved driving a needle bar into the ground to a depth of approximately 3 ft at three points along the services: the curb, the property line, and the basement wall. Atmosphere from the bar hole was passed through a combustible gas detector to determine if gas leakage exists. From this information the condition of the underground structure in the area was fairly well known before it was converted.

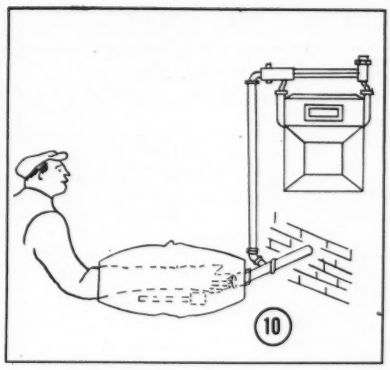
While the house regulators in a conversion area were being installed by conversion crews, the pressure division group was completing the isolation of the area by capping the mains. During the summer months, the pressure conditions in the areas to be converted were good. Mains could be isolated without creating low pressure sections. During the heating season care had to be exercised in completely isolating a heavily loaded section before the house regulator installation was completed and the pressures raised.

The method of capping the mains was as follows:

1. Three holes were tapped in the main and a bag inserted in the middle hole with pressure gauges at the outside holes. As the bag was inflated, the pressures were noted. At any time the pressure went below 5 in. w.c., the bag was deflated and the capping delayed until the house regulator installation was completed.
2. When there was sufficient pressure the bag and pressure gauges were removed and two bags were inserted, one at each outside hole.
3. The main was then cut and a disk ¼ in. larger in diameter than the main was inserted at the cut.
4. Finally a split coupling clamp used for repairing broken mains was placed over

Fig. 9. Service stopper.
Fig. 10. Remove service tee cap; drop into gas retention bag, then insert safety test stopper into service and expand.
Fig. 11. Remove bag and place pressure test nipple over the handle of stopper and secure tightly on service.
Fig. 12. Pressure test nipple.
Fig. 13. Masonry drill.
Fig. 14. Split coupling clamp and disc for gas main shutoff.
Fig. 15. Conversion of low-pressure governor to medium pressure.


BRASS HEX FINISHED NUT
RESILIENT EXPANSION MEMBER
FIBER GAS SEAL
ADJUSTING NUT FOR 1½" AND 1¼" PIPE
KNURLED HANDLE
9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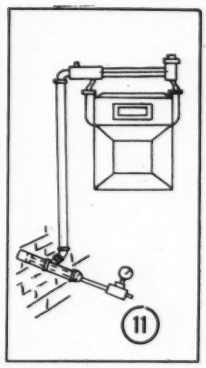
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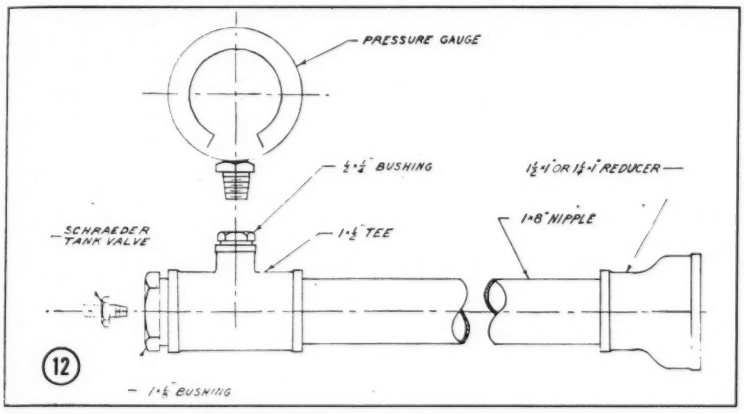
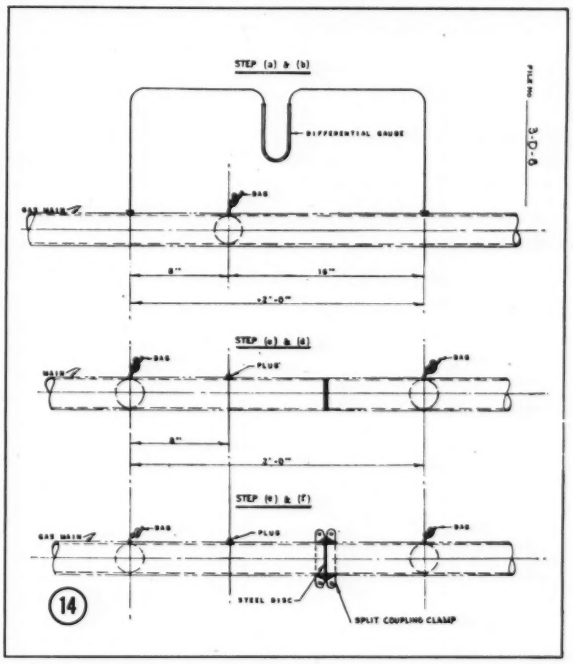
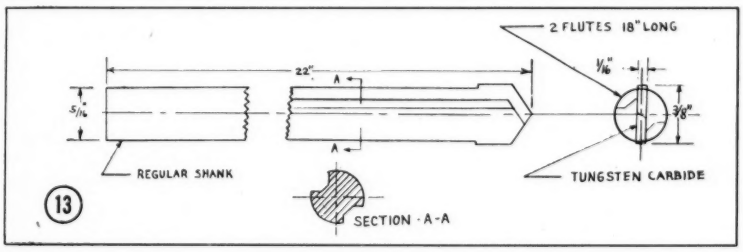

PRESSURE GAUGE
½"×¼" BUSHING
1½"×1" OR 1¼" REDUCER
SCHRAEDER TANK VALVE
1"×½" TEE
1"×8" NIPPLE
12
1"×¼" BUSHING


STEP (a) & (b)
DIFFERENTIAL GAUGE
FILE NO. 3-D-6
GAS MAIN
GAS
8"
18"
+2"-0"
STEP (c) & (d)
PLUG
2'-0"
STEP (e) & (f)
STEEL DISC
SPLIT COUPLING CLAMP
14


2 FLUTES 18" LONG
1/16"
22"
A
5/16"
3/8"
REGULAR SHANK
TUNGSTEN CARBIDE
SECTION · A-A
13

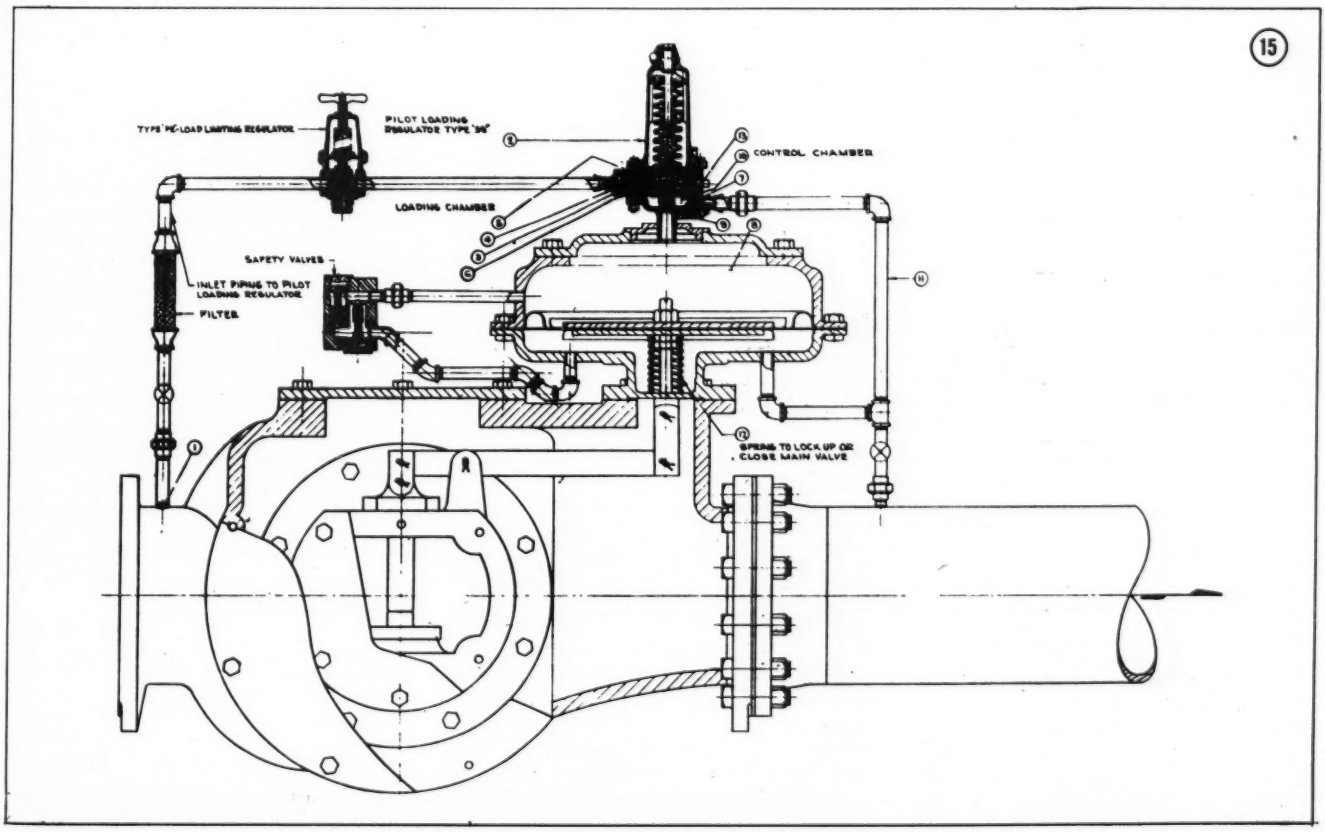

15
TYPE 'PE' LOAD LIMITING REGULATOR
PILOT LOADING REGULATOR TYPE 'SR'
CONTROL CHAMBER
LOADING CHAMBER
SAFETY VALVE
INLET PIPING TO PILOT LOADING REGULATOR
FILTER
SPRING TO LOCK UP OR CLOSE MAIN VALVE

TABLE 1. 1-IN. SERVICE REGULATORS

Inlet and outlet pipe connections	1-in. tapered pipe thread (a standard 1¼-in. connection housing tapped with 1-in. threads is acceptable)
Vent boss tap	¼-in. tapered pipe thread, boss shall accommodate ½-in. of fitting thread without interference with any dampering device such as a marble or pop valve
Valve orifice	½-in.
Diaphragm	Synthetic
Loading medium	Spring
Adjustment settings	1 lb inlet pressure, 7-in. w.c. outlet pressure at 20 ft cfh flow
Performance requirements	Regulators shall have a capacity of 250 cfh with an 8-in. w.c. inlet pressure and a minimum of 5-in. w.c. outlet pressure and shall have a capacity of 600 cfh with an elevated pressure of 1 lb to 10 lb inlet with an outlet pressure of 2 in. w.c. plus or minus the adjustment setting of 7-in. w.c. outlet pressure and maintain a lockup pressure of 8 in. w.c.

TABLE 2. 1½-IN. SERVICE REGULATORS

Inlet and outlet pipe connections	1½-in. tapered pipe thread
Vent boss tap	½-in. tapered pipe thread, boss shall accommodate ½-in. of fitting thread without interference with any dampering device such as a marble or pop valve
Valve orifice	⅞-in.
Diaphragm	Synthetic
Loading medium	Spring
Adjustment settings	1-in. inlet pressure, 7-in. w.c. outlet pressure at 100 lb cfh flow
Performance requirements	Regulators shall have a capacity of 500 cfh with an 8-in. w.c. inlet pressure and a minimum of 5-in. w.c. outlet pressure and shall have a capacity of 2500 cfh with an elevated pressure of 1 lb to 10 lb inlet with an outlet pressure of 2-in. w.c. plus or minus the adjustment setting of 7-in. w.c. outlet pressure and maintain a lockup pressure of 8 in. w.c.

TABLE 3. 2-IN. SERVICE REGULATORS

Inlet and outlet pipe connections	2-in. tapered pipe thread
Vent boss tap	½-in. tapered pipe thread, boss shall accommodate ½-in. of fitting thread without interference with any dampering device such as a marble or pop valve
Valve orifice	1-in.
Diaphragm	Synthetic
Loading medium	Spring
Adjustment settings	1 lb inlet pressure, 7-in. w.c. outlet pressure at 250 ft cfh flow
Performance requirements	Regulators shall have a capacity of 1000 cfh with an 8-in. w.c. inlet pressure and a minimum of 5-in. w.c. outlet pressure and shall have a capacity of 5000 cfh with an elevated pressure of 1 lb to 10 lb inlet with an outlet pressure of 2 in. w.c. plus or minus the adjustment setting of 7-in. w.c. outlet pressure and maintain a lockup pressure of 8 in. w.c.

the disk and tightened. See *Fig. 14.*

The disk used was supplied by the clamp manufacturer.

The low-pressure weight-loaded district governors were converted to medium pressure by applying a pilot loading principle as shown in *Fig. 15.* The pilot loading principle was chosen over the weight loading principle because it would:

1. Relieve the strain on the diaphragm.
2. Permit carrying outlet pressures from 1 to 5 psi without changing the size of the diaphragms.
3. Obtain better control.
4. Convert the regulator so that it would fail closed.

The pressures maintained by the converted governors have been very steady and consequently very satisfactory. It was found that three men could convert two district governors a day.

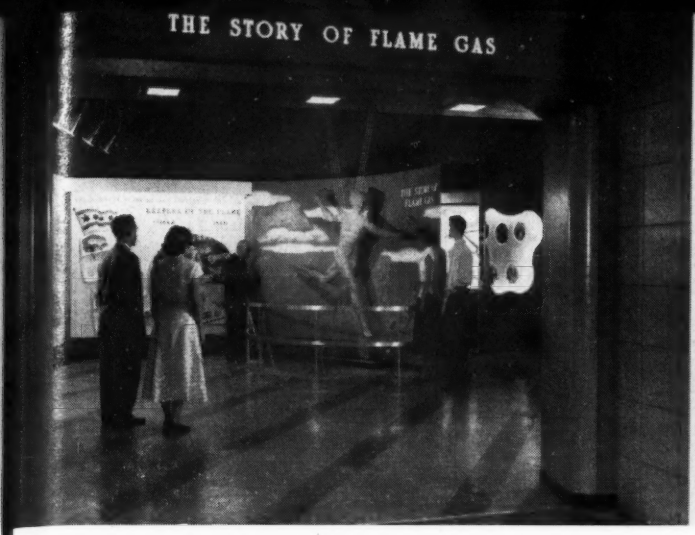
During and following the completion of the conversion a definite pressure schedule was maintained. During periods of warm weather an 8-in. w.c. pressure was maintained at the outlet of the district governors. During the heating season as the load increased, this pressure had to be raised to maintain sufficient pressure in the low points of the conversion area. The amount of this increase varied with the individual district and the average temperature. Maximum pressure to date, 15 in. w.c.

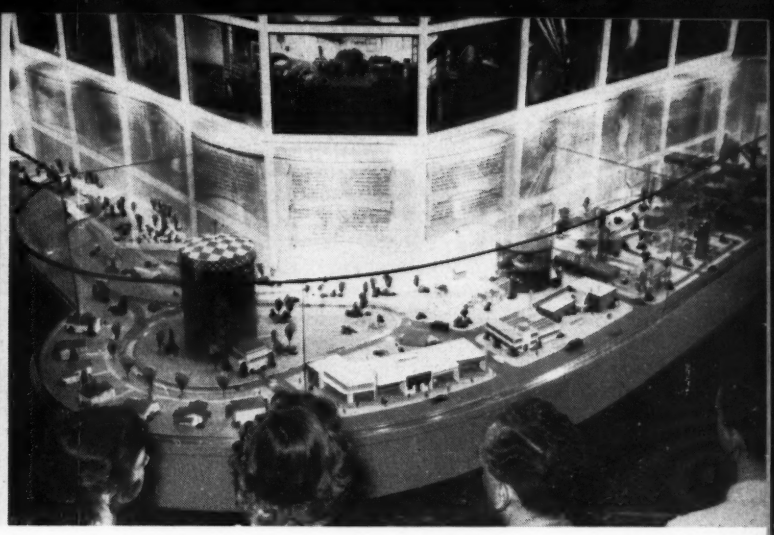
After the conversion has been completed from the standpoint of house regulator installation and area isolation, the pressure was raised 5 in. w.c. At this point a pressure survey was made at the boundaries of the conversion crews to determine that the area isolation was complete. When it was found that the area was completely isolated the pressure was raised 7 in. more and the service shop personnel alerted for complaints. It was found in all cases that complaints were negligible, indicating that the area was completely converted.

The pressure was subsequently raised to 1 psi and another leak survey was conducted by the main and service investigating division, this time only at the basement walls of the buildings. A total of 24,000 services was surveyed in this manner in five days by 30 men for a productivity of 160 services per man per day. After the survey was completed, the pressure was raised to 1.5 psi and a complete leak survey conducted at three points over every service: the curb, the property line, and the basement wall. The average productivity of the men for this type of survey was 80 services per man per day. Any leakage was immediately reported to the street department and the necessary repairs made to either the main or service. Approximately six months after this final leak survey, another complete survey will be made to check the condition of the system under the higher pressures being maintained.

Listed below are the final cost figures for the 1949 conversion consisting of 86,500 installations, 40,719 completed by contractor personnel and 45,781 by the service shop personnel:

Labor	$ 765,600
Material	955,700
Sundry	65,400
Construction engineering and supervision	28,000
General administration	26,500
	$1,841,200
Total number of installations	86,500
Cost per service	$21.20





Peoples Gas Dedicates Big Chicago Exhibit

RUNNING FIGURE of Prometheus, mythical supplier of fire to human race, was sculptured from solid bleached mahogany, is central point of Story of Flame Gas unit of exhibit, above, left. Above, right, is three-dimensional model of installations of a typical gas utility company with mixed gas sendout. It is one of 20 permanent exhibit units.

DEDICATION of a $100,000 permanent exhibit depicting the gas industry and the history of the company that has served gas to the Chicago area since 1855 will be made Sept. 7 by officials of the Peoples Gas Light & Coke Co. The company is contributing the exhibit to the Museum of Science and Industry as part of the commemoration of the 100th year of gas service in Chicago.

Prior to the opening ceremonies that will show Chicagoans the graphic picture of 100 years of utility progress, the company mailed out about 1 million invitations—at the rate of 30,000 a day—to its customers, inviting them to come to see the mammoth display. About 1.5 million visitors tour the museum annually.

James F. Oates, chairman of Peoples Gas Light, will dedicate the exhibit on Sept. 7, and will present it to Maj. Lennox R. Lohr, museum president. Among 500 guests who will attend the ceremonies is a group of five former AGA presidents, appointed by incumbent president Hugh H. Cuthrell to represent the gas industry at Chicago's centennial observation. Included are Everett J. Boothby, president of the Washington (D.C.) Gas Light Co.; R. H. Hargrove, president of Texas Eastern Transmission Corp., Shreveport; Robert W. Hendee, president of Colorado Interstate Gas Co., Colorado Springs; Hudson W. Reed, president of Philadelphia Gas Works Co.; and J. French Robinson, president of East Ohio Gas Co., Cleveland.

Principal speaker at the dinner that will mark the dedication will be Ralph Budd, board chairman of the Chicago Transit Authority, and former president of the Burlington Lines.

The exhibit was planned and organized by a committee headed by Francis X. Mettenet, vice president, and including Remick McDowell, assistant to the chairman; Philip E. Eddy, vice president; Clayton G. Cassidy, advertising director; and Harry Swenson, director of the display and home planning board. Twenty permanent units make up the display. It covers 2400 sq ft of museum floor space, and fills a full-size display room in the world-famous institution. Five different categories are graphically illustrated in the exhibit: history of gas, production of manufactured and natural gas, gas utilization, physics of gas, and research-testing-distribution.

As an example of the different portrayals of the phases of the industry, one of the historical vignettes in the exhibit shows uses of gas by Chinese to dry salt, a typical gas range of the last century, the natural gas fields of Texas, the processes of producing manufactured and mixed gases, the first use of gas for street lighting, and a distribution diagram for a large city.

Working models of gas appliances, and working demonstrations of the many ways in which gas is utilized are included in the show. Actual demonstrations of heat-treating and annealing steel, gas-fired coffee roasters, and the role of gas in making open hearth steel form one exhibit unit. Models of the Chicago distribution system, of a compressor station, and of the Texas gas fields (with gathering lines, booster stations, etc.) will show Chicagoans the mammoth complexity involved in furnishing them with heat for the morning coffee.

STEEL-HARDENING and annealing operation, with gas heat of course, is done automatically in this unit of Peoples Gas exhibit in Chicago Museum of Science and Industry.

TAPERED PORT PIPE BURNERS

By Burnie Porter and
Willard M. Dow

High capacity, extended range of burners may create new industrial commercial gas utilizations.

One of the several basic types of burners using gas as a fuel is the pipe burner, which in its simplest form consists of a closed-end pipe having a row of ports drilled along its length. The gas is introduced through the open end inspirating primary air. The air-gas mixture flows toward the closed or dead end, escaping through the burner ports where the gas is ignited to provide the flame. In spite of its physical simplicity and flexibility it has not been widely used in industry. Apparently its use has been greatly limited because the dynamics of the gas flow have not been considered in its design.

It has been recommended that pipe burners should not be designed for greater than 6 ft and that the cross-sectional area of the pipe should not be less than 1½ times the total port area.[1] Wills[2] made a theoretical study of gas flow through burner manifolds and recommended that the cross-sectional area of the manifold should be about three times that of the port area.Numerous commercial pipe burners are available. They are all very similar in design in that the total port area does not exceed the cross-sectional area of the pipe and that the maximum capacity is about 1300 Btu/hr/linear in. for blue flame operation.

These design conditions of length and area ratio impose serious limitations on the capacity and utility of the simple pipe burner. These burners are now being used in many heating applications such as drying ovens, core and mold baking ovens, electroplating, low temperature melting, large hot plates, indirect heat radiation, heating tanks for boiling and cooking, drying kilns, and similar uses requiring a wide distribution of heat. However, their applications are greatly limited at the present due to their low capacities. A drilled-port pipe burner which could have a high capacity and unlimited length, as well as uniform flame height and heating characteristics, would be desirable and applicable in many heating installations. It would have the advantages of embodying only one primary air inspirator regardless of heating length and of being easily and cheaply constructed. It could be adapted to many heating installations where direct gas flame heating is normally precluded by the high cost and impracticability of a large number of conventional burners.

1. "Combustion, 3rd Ed.," American Gas Assn., pp 122, 132-134, New York, 1932.
2. Wills, F., "Design of Gas Burners by the Use of Fundamental Flow Formulae," *Western Gas*, Vol. 7, No. 8, pp 87-99, August 1931.

AN effort to adapt a constant-diameter pipe burner to the relatively high heating requirement of a lumber dry kiln resulted in a demonstration of the limitations of the simple constant-diameter pipe burner. A non-uniform flame height and distribution of heat was produced by the pipe burner whose total port area greatly exceeded the cross-sectional area of the pipe. A pipe burner designed by conventional standards would have been impractical due

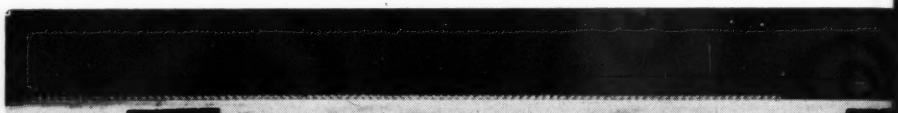


Fig. 1. Commercial pipe burner, low delivery rate.

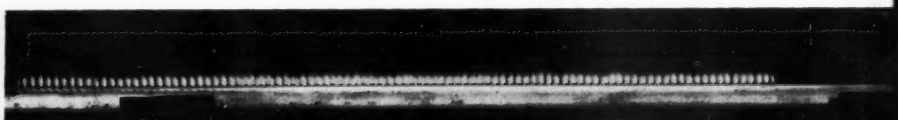


Fig. 2. Commercial pipe burner, high delivery rate.

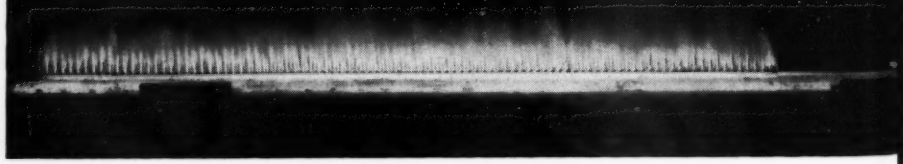


Fig. 3. Commercial burner, high delivery rate, low primary gas-air ratio.

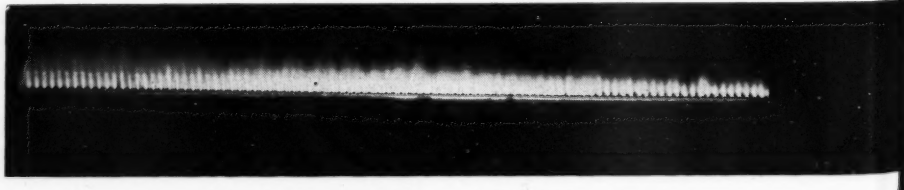


Fig. 4. Modified pipe burner without tapered insert.

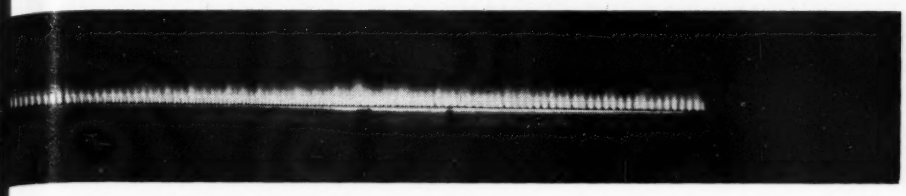


Fig. 5. Modified pipe burner with tapered insert (225% original capacity).

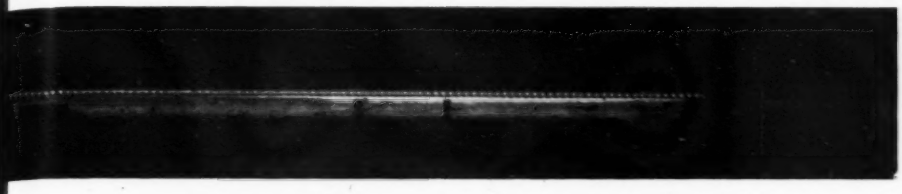


Fig. 6. Modified burner with tapered insert, low delivery rate.

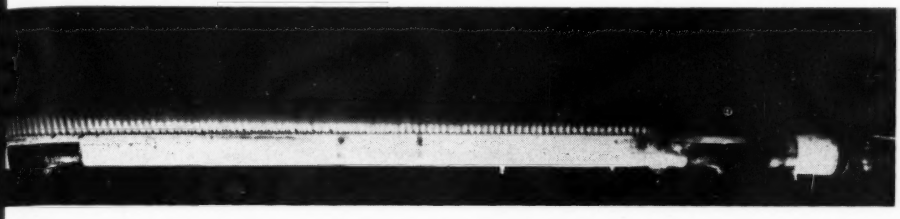


Fig. 7. Modified pipe burner without tapered insert.

to its capacity limitation. It was found that the flame height and distribution of heat along the length of the pipe burner could be influenced by tapering the internal diameter of the pipe. The fundamental aspects of gas flow through a pipe burner were investigated in order to determine the possibility of obtaining desirable and controllable heating characteristics of this simple type of gas burner by means of varying the internal cross-sectional area of pipe with distance along the burner.

Theoretical considerations resulted in equations for the design of pipe burners, as well as a clarification of their operating characteristics. This study showed that drilled-port pipe burners, which have a far greater utility and capacity than now realized, may readily be designed and constructed. Experimental tests with commercial and modified pipe burners verified the validity of the theoretical results.

Briefly, the theoretical treatment consisted of the mathematical development of the necessary conditions to insure that the pressure drop due to friction losses in the flow through the pipe was exactly balanced by the pressure increase due to the deceleration of the flow in the pipe. A deceleration of the main flow necessarily occurs in a constant-diameter pipe when part of the gas escapes through the ports. When these two pressure trends are exactly balanced the gas pressure is constant along the entire length fo the burner, which insures a uniform flame height and uniform heating.

In general, the pressure loss due to friction is related to the internal surface area of the pipe while the pressure gain due to deceleration is related to the cross-sectional area of the pipe. Therefore, it is possible to control the pressure by adjusting the ratio of these two areas. This can be accomplished by several means, such as inserting a tapered plug in the pipe or actually constructing a pipe with a tapered diameter. The first method appears to be the most desirable on the basis of flexibility, economics and ease of construction.

The theoretical analysis showed that it was possible to control the distribution of heat from a pipe burner by the simple expedient of varying the free cross-sectional area of pipe with the distance along the burner. This variation must be made in a definite and prescribed manner dependent upon the physical dimensions and operating rate of the burner.

In general, a uniform distribution of heat is desirable for a heating application. The taper for a high capacity pipe burner simplifies to a linear taper of the free cross-sectional area of the burner as the active length of burner becomes short. The taper is not linear for a high-capacity pipe burner which has a length of a few feet or more.

If the pressure changes accompanying the flow of gas through the pipe are negligible in comparison to the pressure drop across the discharge ports, then the flow will be distributed uniformly through the ports. In effect, this is the case where the manifold is so large that it is equivalent to an infinite reservoir. The dimensions and operating conditions of present commercial pipe burners saitsfy the criteria for this classification. Consequently, even though they operate with a very uniform distribution of heat, they have a low heating capacity.

Figs. 1, *2*, and *3* show a commercial constant-diameter pipe burner, which has 4 ft of active flame length, operating at various rates of flow. This burner is an example of the highest capacity 2-in. diameter pipe burner commercially available. Within its normal operating range it behaves as if the pipe manifold were an infinite reservoir. As the photographs in *Figs. 1*, *2*, and *3* show, this burner produces a uniform flame height and uniform distribution of heat throughout its entire range of operating rates. *Fig. 3* shows the burner operating at a high gas rate of flow but with a limited amount of primary air. The flame was yellow and soft, in contrast to the sharp, blue cones of flame in the other two cases.

Figs. 4, *5*, and *6* show the same burner with the ports and spud enlarged from 1/8-in. to 3/16-in. in order to in-

TABLE 1: EXPERIMENTAL DATA

Burner	FLOW RATES, CU FT/HR Natural Gas	Primary Air	Total	Ratio of Total Port Area to Pipe Cross-Section Area
Fig. 1	10.2	44.1	54.3	0.72
Fig. 2	40.8	164	205	0.72
Fig. 3	103	130	233	0.72
Fig. 4	106	410	516	1.62
Fig. 5	100	380	480	1.62
Fig. 6	9	32	41	1.62
Fig. 7	120	481	601	2.88
Fig. 8	164	670	834	2.88
Fig. 9	300	620	920	2.88
Fig. 10	570	625	1,195	4.32
Fig. 11	580	640	1,220	4.32

Mr. Porter, industrial sales engineer, and Mr. Dow, assistant to director of research, both of United Gas Pipe Line Co., Shreveport, originally presented their paper before the Southern Gas Assn. convention, Galveston, March 27, 1950.

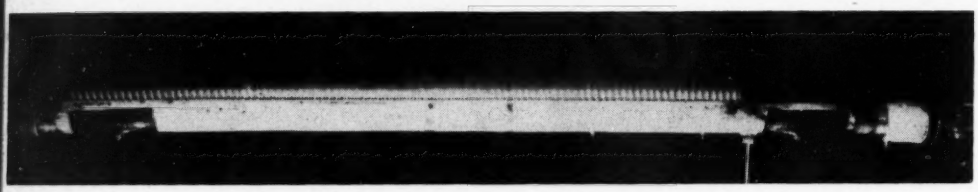


Fig. 8. Modified burner with tapered insert (400% original capacity).

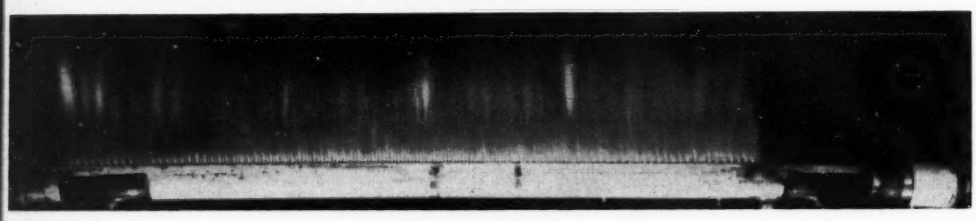


Fig. 9. Modified burner with tapered insert, high delivery rate.

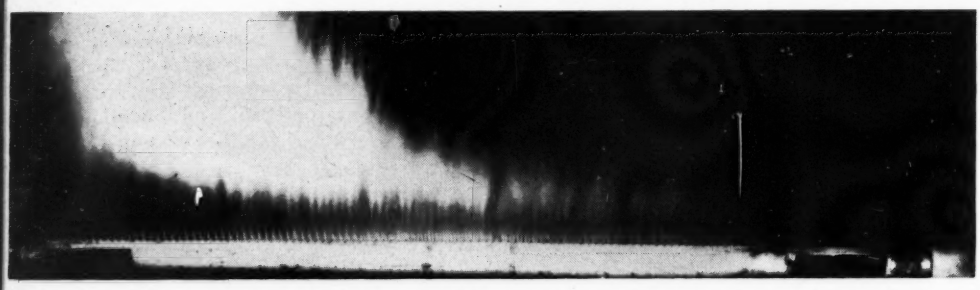


Fig. 10. Modified burner without tapered insert, high delivery rate, low primary air-gas ratio.

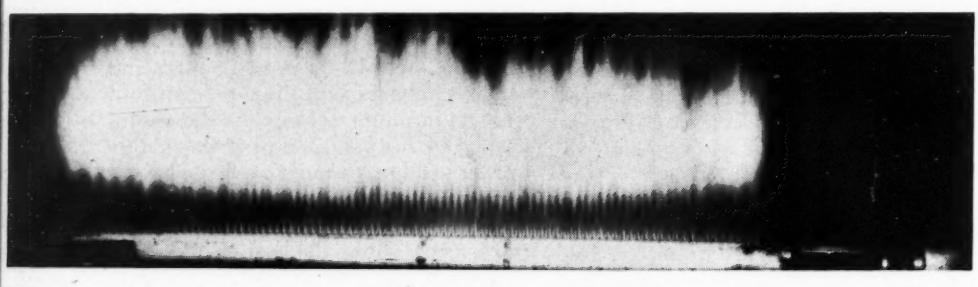


Fig. 11. Modified burner with tapered insert, high delivery rate, low primary air-gas ratio (600% original capacity).

crease its capacity to approximately 225% of that of the original commercial burner. The conditions necessary for the manifold to behave as an infinite reservoir were no longer satisfied and the simple constant-diameter burner did not produce a uniform distribution of the gas as one can see from *Fig. 4*. *Fig. 5* shows the modified burner with a tapered plug inserted in its manifold producing a uniform flame. The tapered insert was designed so that the static pressure would remain constant along the entire length of the burner in accordance with the theoretical design equations. *Fig. 6* shows the modified burner with insert operating at a low rate of flow.

Figs. 7, 8, and *9* show the same burner shown in the two previous series of photographs but with the ports enlarged to ¼-in., which enabled the burner to operate at 400% of the capacity of the original commercial burner. *Fig. 7* shows the modified burner operating without an insert and producing a very non-uniform flame. *Fig. 8* shows the modified burner with an insert operating at the same rate and producing a uniform flame. *Fig. 9* shows the modified burner with insert operating at a high rate of flow. This flame was orange with an occasional streak of yellow in contrast to the sharp blue cones shown in the other two photographs.

Figs. 10 and *11* show the same burner further modified by the addition of a third row of ¼-in. ports and the spud enlarged to ¼-in., which permitted an operating rate equal to 600% of the capacity of the original commercial burner. These photographs were taken with the burner operating with and without an insert under a yellow flame condition of low primary air-gas ratio. They clearly show the difference in the distribution of the heat in the two cases. This burner was successfully operated at higher primary air-gas ratios. The effective turndown ratio of this type of commercial burner is fairly high—in the order of 8 to 1. This ratio was not upset or changed in any way by changing the burner to the higher delivery capacity.

Natural gas of .595 specific gravity and a heating value of 1030 Btu per cu ft at 30-in. Hg, 60°F, saturated, was used in these tests. In no case did the inlet pressure to the burner exceed 12 ounces gauge.

Table 1 gives the pertinent data for the experimental tests conducted.

Potential Applications

This theoretical and experimental investigation has resulted in a rational guide for the design of a simple high-capacity and extended range pipe burner which should have considerable industrial and commercial importance. It has been demonstrated that the conventional low-capacity pipe burner may be converted into a high-capacity and more useful gas burner.

A pipe burner with high capacity and extended range should greatly expand the use of such burners in their present conventional applications. Since this development makes it possible to have either uniform or controlled heat distribution over an extended distance without the limitations of low capacity inherent in present drilled pipe burners, or the high cost of other conventional burners, it should find many uses in other heating applications. Gas heating systems for large drying and baking ovens may be easily and cheaply constructed by the use of this improved pipe burner. It is also adaptable to a conversion type burner for steam and hot water boilers. The basic principle of varying the cross-sectional area of the manifold to provide a uniform distribution of heat is not limited to tubular manifolds, but may be applied to manifolds with other cross-sectional shapes.

Acknowledgement

The assistance of William F. Cummer who conducted all phases of the photographic work is gratefully acknowledged.

Test Meter Method

United Gas applies an old principle in developing a method of determining specific gravity and combined factors of natural gas

By R. Frank Nowlin

SINCE the beginning of time man has searched for easier, faster, and better ways to do his tasks. Perhaps this dissatisfaction of "things as they are" is the dominating influence which causes man to develop new ideas and gadgets. Several years ago United Gas Corp. began to experiment and conduct tests of the possibility of making practical application of an old and well known principle for determination of specific gravity and combined factors of natural gas. Although the general idea is not original, perhaps the application which this company has made of this method as a general practice for use in conjunction with the field testing of large positive displacement meters will be of interest.

Exclusive

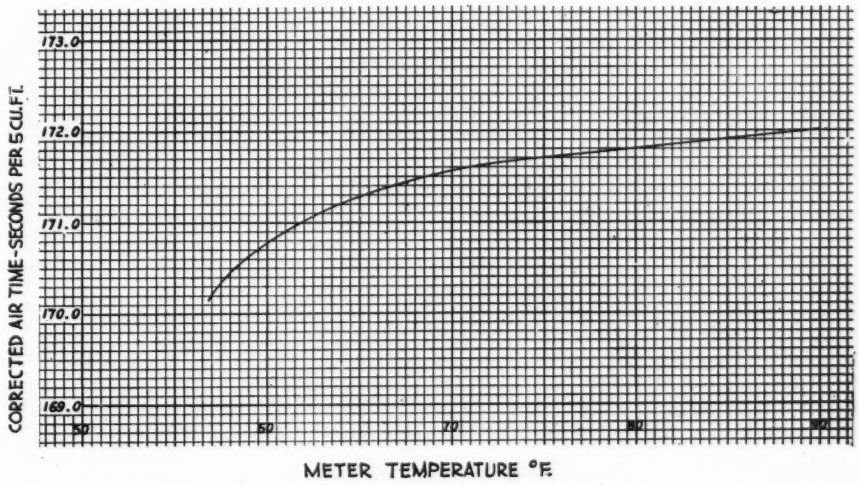
The law of diffusion of gases, on which this method is based, states that two gases under the same conditions of temperature and pressure will escape through an orifice at a rate inversely proportional to the square foot of their respective specific gravities. There is on the market today a simple device for conducting specific gravity tests using this principle. To overcome some of the objections to this device for field work, however, and in addition to develop a rapid method for determining a combined factor (consisting of the specific gravity factor and ratio of specific heats factor) for use with the critical flow prover, the test meter method was adopted for use by United Gas. From the outset, it should be borne in mind that the test meter method described in this paper was developed specifically for use in conjunction with the field testing of large capacity positive displacement meters by means of flow provers of both the low pressure and critical flow types.

Test Equipment Used

The principle equipment used in conducting both specific gravity and combined factor tests consists of the following:

METER. A small positive displacement meter, 25-lb w.p. case, equipped with observation dial is used as the test meter. The capacity of the test meter is 175 cu ft per hr at ½-in. w.c. absorption. The piping on the test meter is arranged to provide a convenient handle and includes ¼-in. inlet connection, thermometer well, ¼-in. pressure tap, and union connection for inserting orifice plates.

ORIFICE PLATES. Two orifice plates are provided. The thin beveled edge orifice plate is used on low pressure



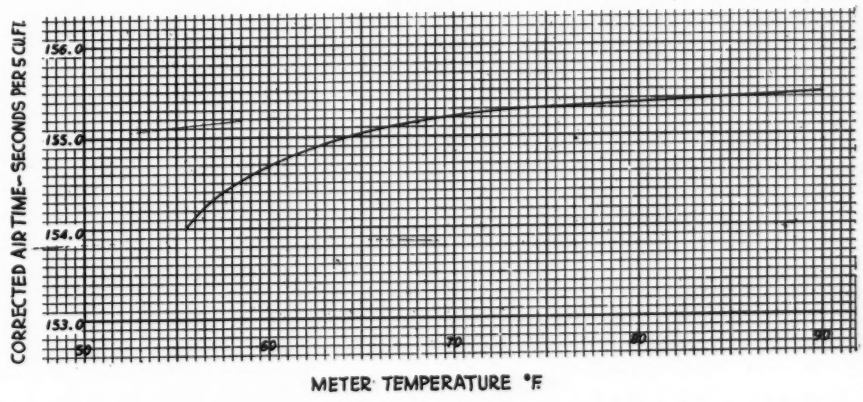


Fig. 1. Sample curve—corrected air time vs. meter temperature. Low-pressure tests for specific gravity factor determination.

Fig. 2. (Bottom). Sample curve—corrected air time vs. meter temperature. Critical flow tests for combined factor determination.

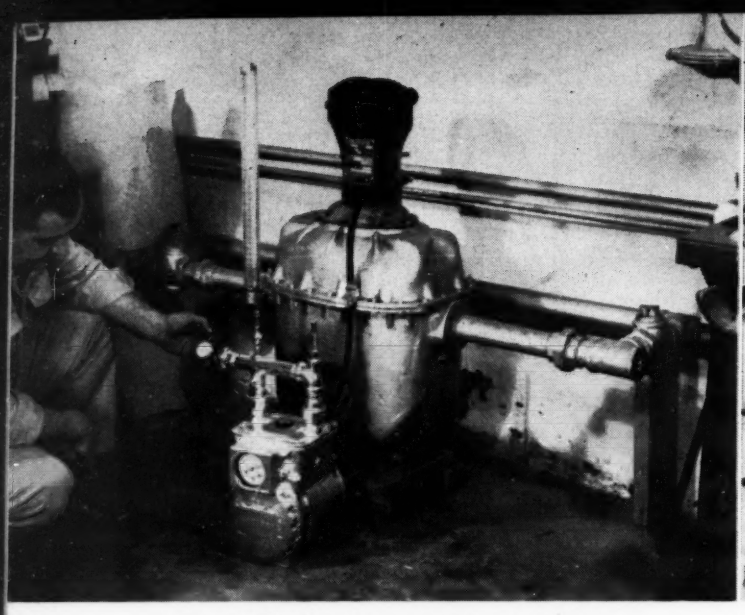


Fig. 3. Test apparatus used for conducting air tests is inspected before tests.

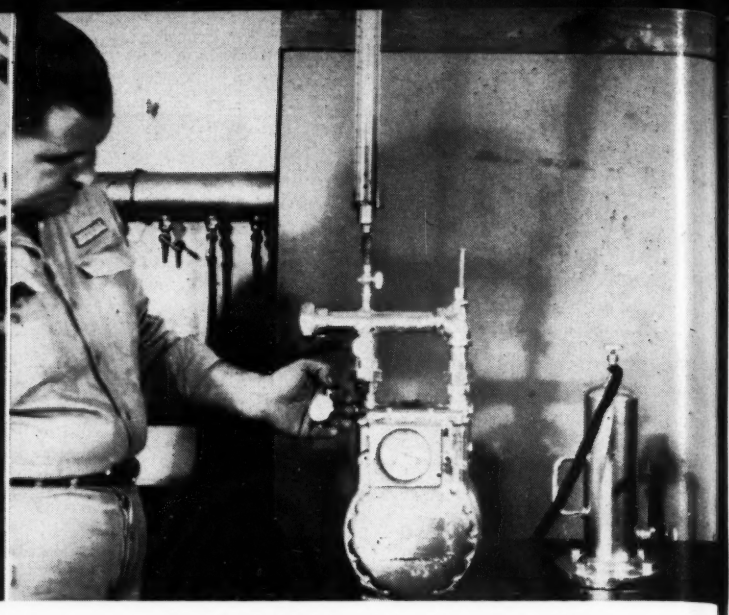


Fig. 4. Inspector conducts gas test. High pressure on meter is employed.

tests for determination of specific gravity factors. The thick trumpet-shaped orifice plate is used only on critical flow tests for determination of combined factors (ratio of specific heats and specific gravity factors).

GAUGES. Two pressure gauges are utilized. The 0 to 12-in. single column water manometer is used for low pressure tests in the determination of specific gravity factors. The 0 to 30-lb inspector's test gauge is used only on critical flow tests for determination of combined factors.

REGULATOR. A ¼-in. regulator, having 250-lb inlet body working pressure, is provided to assist in maintaining a constant pressure on the meter while conducting tests.

AIR DRYER. The air dryer is provided for removing moisture from the compressed air used in making air tests. Activated alumina is used as the drying agent.

THERMOMETER. A 6-in. pocket type thermometer, range 30 to 120°F, with 1° graduations, is used to determine the flowing temperature during each test.

BAROMETER. A standard aneroid barometer is used on the low pressure tests for the determination of specific gravity factors.

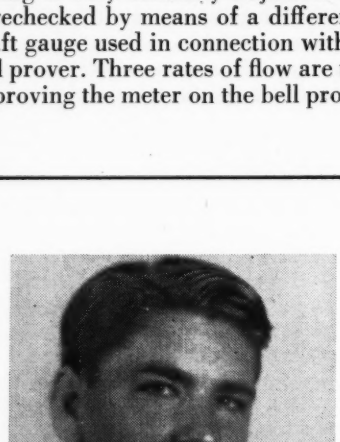
STOP WATCH. An accurate inspector's 17- or 21-jewel stop watch is provided and used for checking the time required for the flow of a given volume of air or gas through the meter and orifice.

Proving and Adjusting Test Meter

After conducting literally scores of tests at widely varying temperatures, we soon discovered that extra precautions were necessary in order to maintain the desired accuracy in results. Since the test meter is the key to accuracy, it is necessary that the proof of the meter remain constant between air tests and subsequent gas tests. Special preparation is given to the meter by making sure that the diaphragms are oiled with only a light weight dressing and that no excess oil remains on the diaphragms. The meter is then thoroughly checked for binds, and the valve timing is very carefully adjusted. This is rechecked by means of a differential draft gauge used in connection with the bell prover. Three rates of flow are used in proving the meter on the bell prover: 175 cu ft per hr, 100 cu ft per hr, and 35 cu ft per hr, as well as the slow light test of ½ cu ft per hr at ½-in. water column pressure. The meter proof is adjusted as close to 100% (0% error) as possible at all three test rates of flow in order to produce a straight line proof curve. After the meter has received its special preparation, it is placed in service on an air line and exercised for several days. At the end of this "breaking in" period the meter is again proved on the bell prover, and, if necessary, adjusted back to its original proof curve.

The effect of temperature on meter proof is illustrated by *Figs. 1* and *2*. Although the ordinate of these curves is specified as corrected air time in units of seconds per 5 cu ft, the data observed therefrom can be readily interpreted in terms of per cent change in meter proof over the range of temperatures covered by the curve. The tests from which these curves were plotted were made over a period of several days, since it was essential that the flowing temperature observed be the true and correct value. *Fig. 1* gives data obtained from low pressure air tests for use in specific gravity factor determination.

The curve covering critical flow air tests for combined factor determination is illustrated in *Fig. 2*.



R. FRANK NOWLIN is director of measurement, United Gas Corp., Houston. He is a graduate of the University of Texas (B.S., petroleum engineering, 1940) and has been with United Gas in the measurement and engineering departments since his graduation.

Application of Method

Our company follows the practice of field testing all large capacity iron and steel case displacement meters by means of flow provers. Since the orifice plates furnished with the flow provers have been calibrated using air as the test medium, the appropriate specific gravity factor or combined factor must be applied when using the respective flow provers in testing meters with gas. Different factors must be determined and

applied when using the two types of flow provers.

In the case of testing by means of the low pressure flow prover, the specific gravity factor must be determined. Where the critical flow prover is used in meter testing, a combined factor consisting of the product of the specific gravity factor and the ratio of specific heats factor must be ascertained. Therefore, the description of the test meter method will be divided into two parts, the first dealing with the determination of specific gravity, and the second covering the determination of the combined factor.

Specific Gravity Determination

The test apparatus used for conducting air tests is illustrated in *Fig. 3*. A small meter equipped with an observation dial and with a low pressure orifice at its outlet is provided. The high pressure air is reduced to the desired pressure by means of the regulator, and then passes through a portable air dryer where moisture is removed. From the dryer, the air enters the inlet of the meter, and the pressure on the meter as indicated by the single tube manometer is adjusted to 9.5-in. w.c. by means of the ¼-in. needle valve. Air is allowed to pass through the meter for several minutes prior to conducting tests in order for the temperature of the air and the meter body to become stabilized.

Fig. 3 shows the inspector conducting an air test and checking the time required for the passage of 5 cu ft of air. The air time thus obtained, pressure on the meter, flowing temperature, and barometric pressure are recorded. The air test time is corrected to standard conditions of absolute pressure, differential across orifice, and temperature by dividing the test time by the product of the pressure factor and temperature factor. The pressure factor is obtained from a table furnished by the low pressure flow prover manufacturer which sets out factors for various pressure differentials across the orifice plate and barometric pressures.

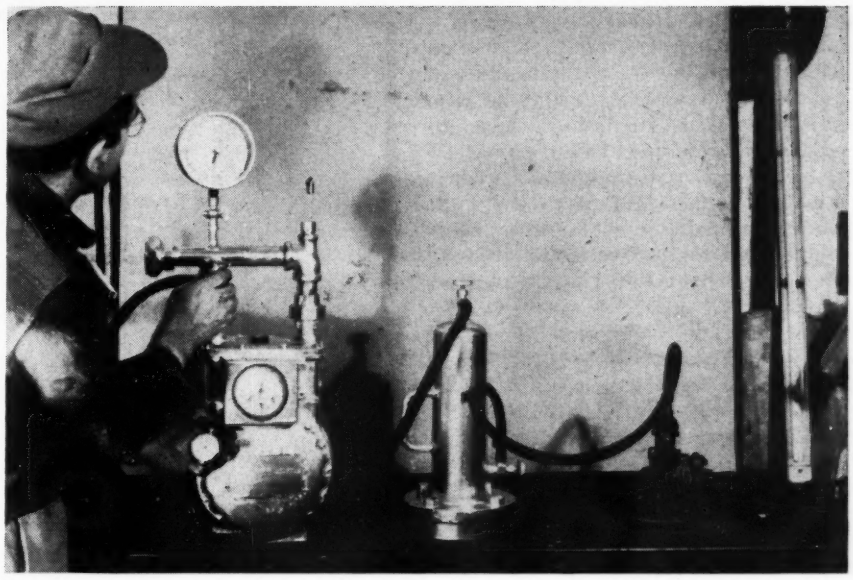


Fig. 5 (Top). Inspector adjusts the needle valve on the inlet of the meter to a pressure of 17 psig. Time required for 5 cu ft of air at 17 psig to flow through the meter and orifice is recorded, as is the temperature. Fig. 6 (Bottom). Inspector conducts gas test, using same equipment except for air dryer.

Gas Tests

The same apparatus is used in conducting gas tests as in air tests with the exception that the air dryer is not utilized. Again, the procedure for making these tests is similar to that followed in making air tests with the exception that the pressure on meter is adjusted to 10-in. w.c. The reason for the slightly higher pressure on meter employed in conducting gas tests is that due to the lower density of natural gas, a slightly higher flow of gas through the meter is necessary in order to produce the same differential in pressure across the meter as experienced in making air tests. *Fig. 4* shows the inspector conducting the gas test. Likewise, the test time for gas is corrected by standard conditions of absolute pressure, differential across orifice, and temperature by dividing the test time by the product of the pressure factor and temperature factor. Again, these factors are determined from manufacturers' tables furnished with the flow prover. The specific gravity factor is determined by dividing the *corrected* gas time by *corrected* air time, and the specific gravity is obtained from a table of factors or by squaring the specific gravity factor.

It is important that the proof of the test meter be the same for air and subsequent gas tests, and that the flowing temperatures of the air and subsequent gas tests be at or near the same value, that is, within plus or minus 5°. Tests indicate that as long as the temperatures obtained on air and subsequent gas tests are within 5°F of each other, satisfactory results are obtained. Experience indicates that it is not necessary to conduct air tests prior to running each gas test. In actual practice, our policy is to conduct air tests in the measurement shop about once each week. Where there is any doubt about the reliability of the results obtained, an air test is run to see that it checks the previous air test results.

Combined Factor Determination

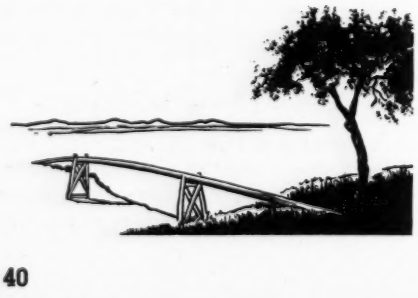
The critical flow prover is used for field testing large displacement meters where the pressure on the meter exceeds 15 psig. Since the orifice plates fur-

nished with the critical flow prover have been calibrated with air, a combined factor which consists of the product of the specific gravity factor and the ratio of specific heats factor must be determined. The combined factor may be arrived at by either of two methods: determination of the specific gravity of the gas, and calculation of the ratio of specific heats from a chemical analysis of the gas, or by the test meter method. The test meter offers a direct method for determining the combined factor and has proved more expedient.

The same test meter is utilized as in conducting specific gravity tests with the exception that a small critical flow orifice is provided in the union on the outlet of the meter. *Fig. 5* shows the inspector adjusting the needle valve on the inlet of the meter to a pressure of 17 psig. The time required for 5 cu ft of air at 17 psig pressure to flow through the meter and orifice is recorded together with the flowing temperature. The air time thus obtained is corrected to the standard temperature base by dividing the air test time by the flowing temperature factor. The temperature factor may be obtained from a table of factors for correcting flowing temperature for measurement through orifices.

The same apparatus is used in making gas tests with the exception that the air dryer is not provided. *Fig. 6* shows the inspector conducting the gas test. A similar procedure is followed as in the case of making an air test with the exception that the pressure on the meter is adjusted to 19 psig pressure. The higher pressure is maintained for gas tests in order to have the same pressure differential across the meter as experienced in running air tests. The gas test time is corrected to standard temperature as done in the case of air test. The combined factor is determined by dividing the *corrected* gas time by *corrected* air time. Again, it is important that the proof of the meter be the same for air and gas tests and that the flowing temperature for air and subsequent gas tests be at or near the same value.

In conclusion, several years' experience with the test meter method for determining specific gravity and combined factors attests that this method is more expedient and that reliable results are obtained when proper precautions are taken in handling the equipment and in conducting the tests.



Overcoming Venting and App

A report on AGA-PAR prog the ... of disposing of prod comb

By KEITH T. DAVIS

Part 2

IT should be realized that the foregoing discussion has been directed toward prompt flue priming without thought of the resultant venting capacity of the flue system during steady state operation. Cognizant of practical draft hood design limitations and appreciating that, like sizing of lateral runs, draft hoods which are strong in one functional requirement may be weak in another, it seems logical to direct a skeptical eye at the vertical flue, the "no moving parts" device which converts heat energy into a flue gas pump. The vertical flue has a remarkable ability to adjust itself to a wide range of conditions but some knowledge of the rule governing its behavior must be known in order to analyze the reasons for those occasional and unusual complaints.

Heat Content

To understand what happens to the mixture of combustion products passing through a draft hood, it must be remembered that the volume of flue gas which any vent system can handle depends upon the heat content in those products. If the temperature of the flue gas is high as it enters the draft hood, a great deal of dilution air is drawn in, the limit being that point at which the friction effect due to increased flow balances against the initially high temperature. If the temperature is low as flue gas enters the draft hood, the dilution air quantity will be less. Note that dilution air neither adds nor removes heat from the flue gas although it does reduce the temperature of the mixture. The energy which creates flow is a function of the total heat in the combustion products leaving the appliance—this lost heat commonly being known as its flue loss, expressed as a percent of its gas input rate.

Visual Aid

Fig. 6 has been developed as an aid in visualizing what happens to the combustion products between the draft hood and the chimney collar. After complete combustion of any given gas, the percent of carbon dioxide in the mixture is a definite indication of the volume of flue gas mixture. In *Fig. 3* (see *GAS*, August 1950) it will be noted that perfect combustion with 0% excess air results in 10.5 cu ft/hr of flue products (at standard conditions) for each 1000-Btu input. Projecting to the left from a more normal CO_2 value ahead of the draft hood, it can be seen the 8.5 CO_2 level intersects the "excess air curve" at 37% excess air (top scale) and 14 cu ft/1000-Btu input on the bottom scale. If the temperature ahead of the draft hood is found to be 500°F, the flue loss of the appliance is equal to approximately 22% of each 1000-Btu input. This is the heat in the flue gas mixture entering the draft hood.

Assuming there is negligible heat lost from the draft hood and the vent line to the chimney, this same 22% of each

pply Problems

rog the research into methods

rod combustion.

This instalment concludes Mr. Davis' paper, the first part of which appeared in GAS for August. Mr. Davis is chief engineer, Bryant Heater division, Affiliated Gas Equipment Inc., Cleveland; his paper was originally presented at the AGA domestic gas and research and utilization conference, Cleveland, April 25-26.

1000-Btu input should be available at the chimney collar to establish some degree of stack action. Whatever this stack effect, the resultant condition of the diluted mixture will remain on the 22% flue loss curve. Should dilution increase from 37% excess air ahead of the draft hood to 300% after the draft hood (CO_2 of this mixture 2.8%), the temperature of flue gases at the chimney should be approximately 230°F. The volume of flue gases per 1000-Btu input has increased from 14 cu ft to 39 cu ft. If this 230°F flue gas temperature fails to develop sufficient stack effect to carry away the resultant volume of mixture, conditions will automatically adjust themselves to balance out at a higher temperature and a lesser flue gas quantity. This self-balancing faculty of a chimney or vertical vent stack is the result of certain fundamental laws governing chimney performance. The theoretical draft developed by a stack is increased as the flue gas temperature rises, as the outdoor temperature drops, as the barometer rises, and as the stack height increases. This stack effect is then available to overcome the friction created by flow of flue products through the horizontal vent connection and the vertical stack. In some cases the stack effect must be enough greater than the frictional loss to offset a slight difference in pressure which may exist between the inside and outside of the building.

Note that for any given chimney, the draft effect is improved if the temperature of flue products is not allowed to drop. Protecting the vent system from thermal losses is beneficial. Reducing the amount of dilution air not only increases the temperature of the stack gas but also reduces the volume of products and therefore, the frictional effect which the stack draft must overcome.

Considerable research work has been done toward determining the quantities of gas which will flow at various temperatures through various arrangements of vertical, or horizontal conductors. Some of the best known, yet least utilized, work was reported some 15 to 20 years ago by Kratz and Konzo[1] at the University of Illinois. It is true this work was done on metal stacks only to determine the heat which could be delivered through warm air gravity piping arrangements. Tests were run on various heights, sizes and shapes of vertical stack with both long and short supply runs graded upward at various angles. Reports record flow data at various relationships of leader pipe area to vertical stack area, and under conditions of exposure to various ambient temperatures. Air entered the test systems at temperatures of approximately 200° which is not too different from that of diluted flue products leaving the draft hood. The familiar 201 Btu delivered to the third floor per hour per square inch of leader area is roughly indicative of 1.79 cfm per square inch of stack, or the approximate volume of diluted flue products (75% excess air) resulting from a combustion rate of 6000 Btu/hr. Considering the different intent, technique, and temperatures of the warm air research work, this value checks well with the frequently cited 6000 to 7500 Btu/hr "rule of thumb" for flue loading. This warm air value should be adjusted, of course, to compensate for higher flue gas temperatures, for shorter stacks, or for stack areas which are appreciably less than 30 sq in. or 6-in. round.

The work of Wills[2] is probably the best known and the most helpful in quickly selecting a logical size vertical stack for a given firing rate. These sizing charts convert directly from gas input rates to diameters of flues of given height chimneys. A series of sizing charts has been prepared to adjust for different excess air quantities, different entering flue gas temperatures, and different frictional effects resulting from varying lengths of horizontal flue collectors. One such chart appears in the ASHVE Guide and another will appear in the soon-to-be-printed ASA Standards for Installation of Gas Piping & Gas Appliances in Buildings.

The Purdue report indicates for equal heights and total heat input 3-in., 4-in., and 5-in. stacks develop flue gas capacities proportional to their areas. This is true only up to the point where the frictional effect created by added height begins to equal the theoretical stack effect developed by each additional increment. With approximately 10,000 to 12,500 Btu content in the flue products entering the draft hood, additional stack heights add very little flue gas handling capacities above 15 ft for the 5-in., 11 ft for the 4-in., and 6 ft for the 3-in. diameter vents. In the same range of heat content in flue gases, it was found the frictional effect resulting from increasing the length of lateral connections reduced the flue capacity but changing the pitch of the lateral had insignificant effect on flow rates. For any given flue system, an increase in heat content in the flue gas resulted in an increase in flue gas velocity. If the present data were tabulated on the basis of heat content in stack gases, and additional test runs made, it might be possible to correlate and extend present quantitative sizing methods.

The foregoing investigations of venting characteristics were directed specifically toward performances on gas equipment incorporating draft hoods. Recent work has been done at Battelle[3] and the Bureau of Standards[4] aimed at determining the draft tension developed in chimneys of varied construction materials, having heights of 13 ft and 15 ft above the centerline of their inlet collars, and when being supplied with various volumes of flue products at various temperatures. In both test laboratories city gas was used as the heating fuel, air for combustion being metered separate from the fuel. All chimneys were of masonry construction, some with and some without liners, some liners being rectangular, square and round terra cotta, others round steel vent pipe. In some instances thermal insulation was applied between the liner and masonry.

Construction Materials

The conclusions reported indicate that materials of construction did not noticeably change frictional resistance due to flue gas flow. Stack drafts were superior where thermal construction of chimneys helped to conserve their heat in the flue gases. It was also noted that at low flow rates, flues did not develop as high a stack pull for a given temperature as they did at higher rates. The Battelle investigators suggest this can be attributed to recirculation within the flue causing turbulence and unanticipated frictional resistance. They found actual evidence of cold outside air entering the top of the chimney and drifting downward during periods of low flue gas flow.

Fig. 7 has been developed from data given in the Battelle report for a typical chimney. It may be noted that for flow rates either larger or smaller than 2000 cu ft/hr, the available draft decreases

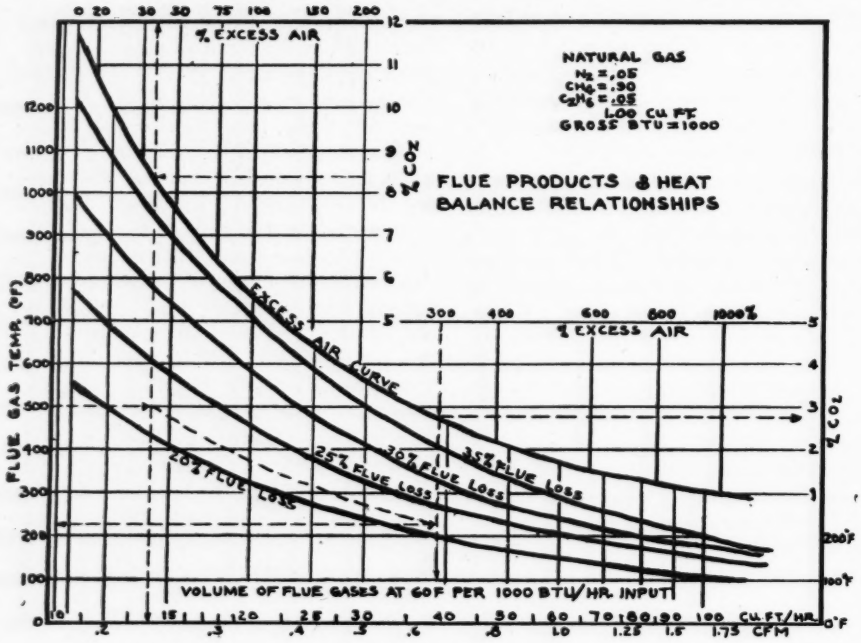


Fig. 6. Flue products and heat balance relationships.

for any given flue gas temperature. On larger flow rates more of the theoretical draft is required to overcome the increased flow resistance. At lower flow rates some of the draft tension is wasted on turbulence and recirculation losses within the flue.

Applying to *Fig. 7* the same set of conditions plotted in *Fig. 6*, and assuming an input rate of 145,000 Btu/hr into the appliance attached to this 6¾-in. x 6¾-in. flueway having an effective height of 13 ft, the chimney would need handle only 2000 cu ft/hr of 500°F flue gas if there were no dilution at the draft hood. But additional dilution will take place unless the .068-in. H_2O draft tension developed is utilized, in whole or part to overcome some atmospheric pressure difference between indoors and outside. If this draft tension is not required, the chimney will rebalance the flow rate to, for example, the second set of conditions from *Fig. 6*, where 300% excess air results in a stack temperature of 230°F and 5660 cu ft of flue mixture. Even this develops a draft tension of .014-in. which may be in excess of the frictional losses due to flow resistance between the draft hood and the chimney. If there were 0 frictional loss and 0 atmospheric pressure difference, the chimney action would automatically rebalance itself at 0-in. draft tension which corresponds exactly with the 200° F stack and 45.3 cu ft/hr (X145 = 6600 total cu ft/hr) values obtained from both *Fig. 6* and *Fig. 7*.

Two additional sets of 22% flue loss abscissa and ordinant readings obtained from *Fig. 6* (100% excess air, 19.9 cu ft x 145 or 2880 cu ft/hr at 375°F and 27.5 x 145 or 4000 cu ft/hr at 290°F) have been plotted in *Fig. 7* to validate the dotted oblique line which establishes the loci of chimney operating conditions under varying indoor to outdoor pressure differences ranging from 0 to .068-in. H_2O.

That such a difference between indoor and outdoor pressures may exist is an occasional possibility due to an unusual position of a chimney crown with respect to nearby wind deflecting obstacles or due to operation of fan equipment which exhausts air from the space in which the gas appliance is installed. A down-draft of the magnitude of 0.1-in. H_2O is a possibility if the top of the vent stack terminates within a "pressure pack" zone created against a wall or roof by a high velocity wind. Purdue Report No. 2 on venting is of qualitative aid in visualizing the extent and regions of surface pressures created by wind velocities from different angles. The pressure curve contours can also be used as a helpful means in assuming the depth of pressure packs through which vent extensions should extend. The usually recommended 2-ft extension above the nearest obstruction within 20 ft is generally adequate, but obviously is illogical if it places the vent outlet within 20 ft of an unusually large vertical surface or between two extremely tall buildings.

Research continues on different designs of vent caps but as yet proof has not been submitted of benefits gained from the use of these gravity hoods except during periods when they are exposed to wind velocity. When a vent cap becomes submerged in a pressure pack region, it is hardly in the path of high velocity air movement, so the cap fails to eliminate down-draft on the flue. Some vent hoods have been found to accelerate stack action when winds approach from most angles but to increase down-draft tendencies when the angle of wind direction changes. A few vent caps are so built that their contribution to up-draft is cancelled by their high internal friction which restricts normal flue gas flow. Vent cap performance is difficult to test and report for the operation of the device is affected by its proximity to adjacent surfaces, the angular displacement of the surface, and the instantaneous direction and velocity of the wind.

Mechanical exhausting of air from the space in which a gas appliance is located is also a possible cause of pressure differences which can create down-draft. An example may be cited in a kitchen ventilating fan rated to expel 300 cu ft per minute, in which case the infiltration rate to a home having the 145,000-Btu input furnace *(Fig. 6* and *Fig. 7)* must equal or exceed the 300 cu ft of fan air, plus 34 cu ft (.234 cfm x 145) of flue products without reducing the indoor pressure more than .068-in. below outdoor air if draft hood spillage is to be avoided. This 334 cu ft/hr is exactly equal to one air change per hour in a home of 20,000 cubical content which might well have a heat loss of 100,000 Btu/hr, and so require the installation of a forced air furnace of approximately 145,000-Btu input. Inasmuch as a normal infiltration rate equaling one air change per hour is a frequent assumption, it might well be that this kitchen fan installation would not tend to reduce the interior pressure below that outdoors.

Delayed Priming

Should the normal infiltration rate be less than 334 cfm, or should there be other exhaust pumps, such as a high temperature operated fireplace flue, the priming of the furnace vent may be delayed or possibly never be established if air removal from the house created an indoor pressure deficiency approximating .068-in. H_2O.

This introduces the question of what is a logical assumption as to the normal infiltration rate for a building of average construction. In this connection it is interesting to note that uncompleted research work at the University of Illinois (DGR-7-CH) indicates that in Research Residence No. 2, a small home fully weatherstripped, vapor sealed, and insulated on both side walls and ceiling, indoor pressures were observed to increase above outdoor pressures as wind velocities increased, varying from a minimum of —0.002 in. during a period of zero wind movement to recordings in excess of +.05 in. w.c. at wind velocities of 12 mph.

While these data do not directly re-

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veal infiltration rates, additional introduction of air into the test house at a rate equivalent to 1½ air changes per hour did not create an indoor-outdoor pressure differential sufficient to detect on a slope gauge reading to 0.001 in. of H_2O. These data would apparently warrant the conclusion that considerable infiltration and exfiltration (1½ air changes per hour) can take place in a tightly constructed home without encountering indoor negative pressures which would cause reversal of normal flow through a well designed gravity venting system.

Room Fumes

A word of caution is offered in connection with another type of fan system. If a gas-fired forced air unit draws air for recirculation from the same space as it obtains its combustion air, and the circulated air is then delivered to other and indirectly connected spaces, it is possible for the appliance fan to so evacuate the equipment space as to reverse the stack, create continuous flue gas spillage, and blow this combustion product mixture into the areas to be heated. This condition may arise when a unit heater discharges its circulating air through a tight partition. It may occur when a forced air furnace is installed in a basement without a continuous and tight return air duct system, unless adequate provisions are made for easy flow of return air into the basement space. The more frequent error in judgment arises from failure to properly handle and separate the air for recirculation from the air for combustion in the case of forced air furnaces installed in confined spaces or closets.

The AGA's Domestic Gas Research investigation of this problem[5] is reported in Bulletin No. 53. It recommends that all return air connections to the furnace be tightly ducted through the confines of the equipment room so that no return air can be drawn from this space. Air for combustion, and the ventilating air necessary to avoid a hazardous temperature rise in this space, is then handled by two openings, one near the ceiling and one near the floor, each having a free area of one square inch for each 1000 Btu of total input for all appliances within the enclosure. This arrangement, illustrated in *Fig. 8*, provides adequate ventilation within the appliance room enclosure to rid the space of flue product spillage through the upper opening while uncontaminated combustion air enters through the lower opening.

Analyzing the arrangement pictured, it is obvious that where a boiler or a furnace is installed in such a ventilated closet, its problems of combustion air requirements are exactly similar to those of a space heater or unit heater sized for the same input to heat the same space. Referring again to the example of the 145,000 input unit in a 20,000 cubical content home, the outside air required to replace the volume of flue products entering the draft hood is equal to the extremely low infiltration rate of one-tenth of an air change per hour. Quantity-wise this is less than the volume of combustion air which would be required were the same heat developed through combustion of coal or oil. Should a home have a ratio of normal infiltration to cubical content which is less than 1 to 10, the problems of excessive humidity and bothersome condensation, of cooking and living odors, of stagnation and mildew growth, would create earlier and more important causes for complaint than would the limited spillage of combustion products. Consequently, the usually reported gas venting mystery malady should not be attributed to lack of infiltration equal to the combustion air needs but to lack of stack effect sufficient to overcome spillage under unusual indoor-outdoor pressure conditions.

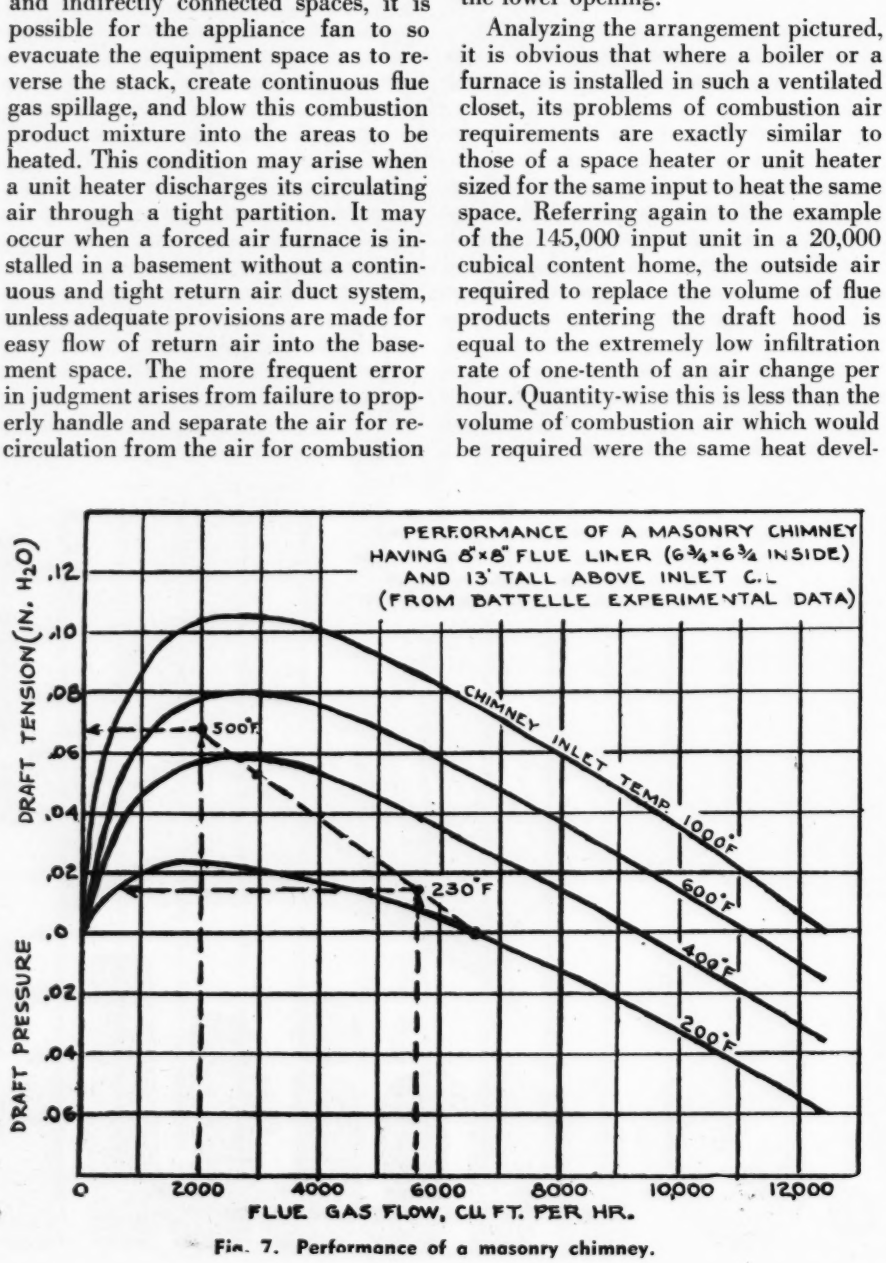
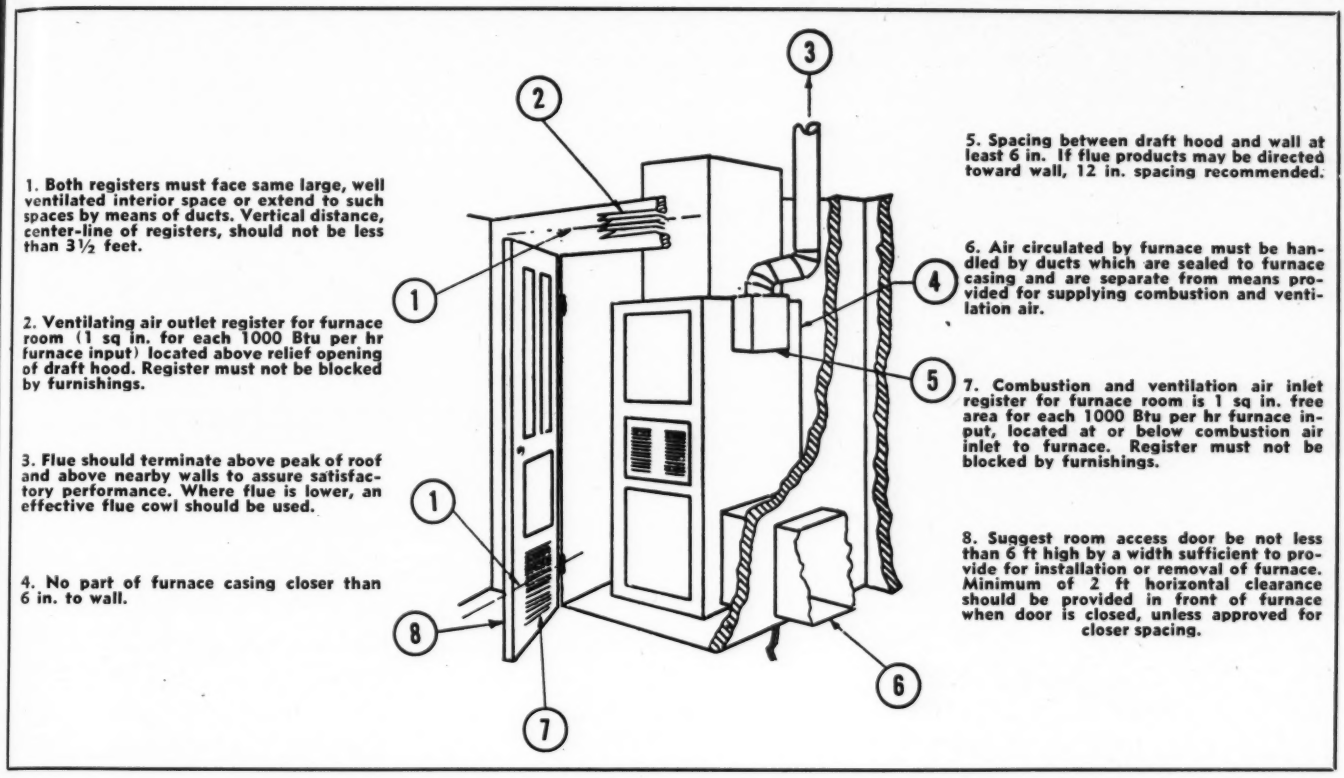


Fig. 7. Performance of a masonry chimney.

Another Problem

A different problem arises if the confining closet is so located that its upper and lower ventilating openings cannot communicate with freely inter-connected room areas, which combined have an adequate infiltration rate. This situation might occur where the two openings from the closet cut through into a small central hallway possible of isolation from the rest of the house by the closing of doors. In such instances the proposed "Standards for Installation of Gas Piping and Gas Appliances" recomends the two openings be extended to a source of adequate outdoor air, both ducts always terminating in a region where they will be equally affected by wind pack pressure. In such instances, the area of each opening may be reduced 50%, with connecting duct work of this same cross-section and with the upper duct either horizontal or graded upward from the installation room.

As part of Project DGR-7-CH at the University of Illinois, data are being gathered on the flow of air for combustion and ventilation to a tightly confined furnace enclosure. In this instance, both duct connections extend upward into a ventilated attic, one duct originating near the floor of the furnace closet and the other near the ceiling level. These ducts, originally sized on the basis of 1 sq in. of cross sectional area may be cut in half without appreciably altering the performance of the stack or changing the ambient temperature of the enclosure, thus tending to verify the sizing practice to be described for such "snorkel installations" in the pending AGA gas appliance installation manual. This type of installation appears to offer the most sensible solution to the problem created by use of kitchen exhausters and attic fans of good static pressure characteristics which attempt to discharge air faster than infiltration occurs. Depending upon the fan capacity, it may be necessary otherwise to fully open a window


1. Both registers must face same large, well ventilated interior space or extend to such spaces by means of ducts. Vertical distance, center-line of registers, should not be less than 3½ feet.
2. Ventilating air outlet register for furnace room (1 sq in. for each 1000 Btu per hr furnace input) located above relief opening of draft hood. Register must not be blocked by furnishings.
3. Flue should terminate above peak of roof and above nearby walls to assure satisfactory performance. Where flue is lower, an effective flue cowl should be used.
4. No part of furnace casing closer than 6 in. to wall.
5. Spacing between draft hood and wall at least 6 in. If flue products may be directed toward wall, 12 in. spacing recommended.
6. Air circulated by furnace must be handled by ducts which are sealed to furnace casing and are separate from means provided for supplying combustion and ventilation air.
7. Combustion and ventilation air inlet register for furnace room is 1 sq in. free area for each 1000 Btu per hr furnace input, located at or below combustion air inlet to furnace. Register must not be blocked by furnishings.
8. Suggest room access door be not less than 6 ft high by a width sufficient to provide for installation or removal of furnace. Minimum of 2 ft horizontal clearance should be provided in front of furnace when door is closed, unless approved for closer spacing.

or door to equalize indoor-outdoor pressures so that gas appliances may vent without spillage. This may not be objectionable to improve water heater venting during the summer, but it cannot be considered practical during the winter.

Unless very unusual steps are taken to protect against its corrosive effects, condensation of flue products within the venting system is to be avoided. Condensation results from moisture-laden combustion products being exposed to surfaces below the dew point temperature of the particular flue gas mixture. Data on condensation situations given in DGR Bulletin No. 51[6] indicate that dilution of combustion products results in the lowering of the temperature at which condensation occurs, but at a rate which roughly approximates the reduction in temperature of the flue gas mixture due to the same dilution. Technically, dilution does not "dry out the flue gas" but it may dry out a flue. First, because of the lowered dew point, the walls of the flue will not have to be kept as warm in order to stay above the dew point temperature. Second, if the flue material need not be kept as warm, its temperature, as compared with outdoors will be reduced so that less heat input is required and more heat can be retained in the flue gas to improve draft tendencies. Third, the added volume of flue products permits more uniform heating of all flue surfaces since it tends to block the flow of cold outdoor air downward into the stack.

This curious counterflow condition in vertical stacks is most apt to occur where the cross-sectional area of the stack is greater than that of the flue gas connections made thereto. Any draft tension developed in the vertical flue must be dissipated and if the friction of increased flow through draft hoods and horizontal vent connections is greater than the friction due to turbulence and counterflow circulation within the oversize stack, the latter will occur along with possible evidence of condensation during cold weather. This situation might be predicted from the Battelle report which in *Fig. 7* indicates a reduction in chimney efficiency under low volume flow conditions. To avoid condensation problems flues for gas appliances should be sized as small as is practical for the Btu loading anticipated.

Conclusion

While research will be continued in an effort to develop quantitative answers to many of the perplexities of appliance venting, it is felt there are no unsolved mysteries interfering with understanding of the basic fundamentals. Because the operation of a venting system depends upon many variables such as:

1. Flue gas temperature and volumes
2. Spillage and dilution characteristics of draft hoods
3. Stack heights and cross-sectional areas
4. Vent connection lengths, diameters and pitch
5. Thermal mass and insulation of vent systems
6. Wind effects on infiltration and vent tops
7. Competitive air exhausting equipment

and any of these variables may change independently, conceivably it may prove impractical to develop a general rule or formula for vent installations which is useful, let alone understandable. It is believed the logical characteristics of venting systems can be described in more interesting detail and simpler form than has been done in this paper, and it is then the industry's duty to see that those who specify and install gas appliances become sufficiently familiar with the fundamentals that better judgment may be exercised in making future recommendations. While this prediction of the future may not be as simple as desired, there is nothing in the picture to merit a loss in confidence in gas equipment, or the service which such equipment renders to the utilities' customers.

Rather, the present attention to venting methods is clearly indicative of the gas industry's determination, through sponsorship of proper installation of good equipment, consistently to improve the quality of performance rendered and so continue to merit the public's confidence and acceptance of gas as the perfect household fuel.

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6. The Effect of Modulated Operation on Performance of Gas Warm Air Furnaces—DGR Bulletin No. 51—AGA laboratories

Fig. 8. Extraction thimble inside the bottle. Each thimble is transported to and from the field in one of the sealed bottles, the weight of which is known.

Performance Tests On Oil Contact Gas Scrubbers

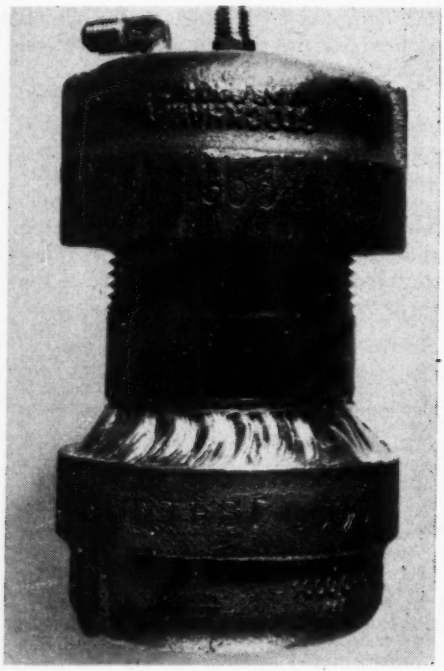
By P. W. McDonald and E. M. Woods

PART 2

IN order to determine the actual capacity of these scrubbers, tests were conducted to determine the oil loss by mechanical entrainment at different gas rates. The test procedure was adopted from a method for determining the concentration of dust carried in gas lines. Special techniques were employed so that the oil as well as dust carried in the gas could be determined quantitatively.

In this method of test a gas sample is withdrawn through a 0.185-in. ID (¼-in. OD) sampling tube installed in the gas discharge line of the scrubber and passed through a filter paper thimble connected to the inlet connection of a sampling cylinder. From the sampling cylinder the gas sample passes through a manifold, through a pressure reduction regulator, and then through a positive displacement meter to the atmosphere. A sample is likewise taken from the gas inlet line of the scrubber.

Fig. 9. Sampling cylinder. In test, bottle, with cap removed, is placed in the thimble cylinder.



The tip of the sampling tube faces upstream and is located at a point of average velocity in the inlet or discharge line of the scrubber. Previous experiments have shown the point of average velocity to be ⅛ of the inside pipe diameter, measured from the top inside wall in a horizontal pipe or from any side in a vertical pipe.[1]

During a test the gas sample is withdrawn at a rate which provides a linear velocity in the 0.185-in. ID sampling tube equal to the average linear velocity of the gas in the line from which the sample is obtained. To facilitate a rapid adjustment of the sampling rate a curve was prepared by plotting gas rate versus sampling rate for each size of line from which a sample was to be taken.

The filter paper thimbles are condi-

This is the second and concluding part of Mr. Woods' and Mr. McDonald's PCGA paper, the first half of which appeared in GAS for August.

This paper was originally presented by Mr. McDonald (Southern California Gas Co.) and Mr. Wood (Southern Counties Gas Co.), Los Angeles, at the PCGA technical services conference, San Diego, March 8-9.

[1]Blaw-Knox Bulletin No. 1697.

TABLE 1

OIL LOSS DATA FOR SMALL HORIZONTAL SCRUBBER

Gas Rate Through Scrubber MMcf per Hour	Average Operating Pressure, psig	Equivalent Gas Rate at 400 psig, MMcf/Hr	Oil Loss Gal./MMcf
1.03	290	1.2	0.0
1.51	335	1.65	0.0
1.77	320	1.97	0.058
1.81	293	2.1	0.140
2.0	262	2.44	0.503
2.51	257	3.1	3.69

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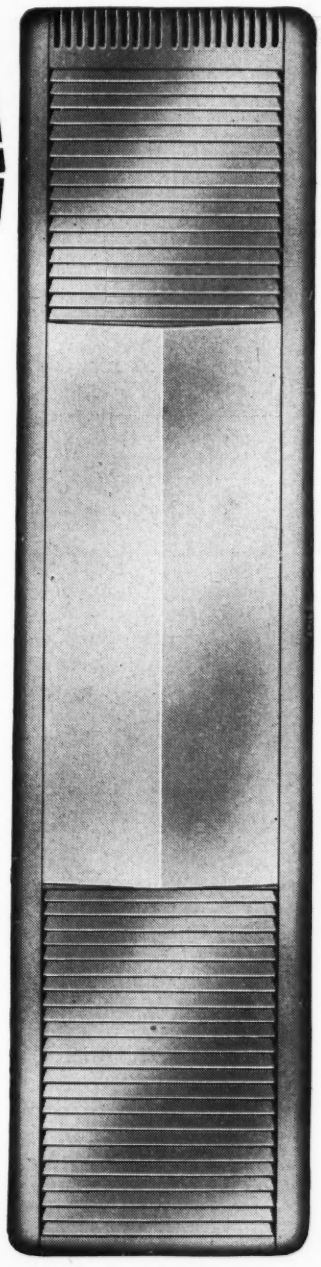

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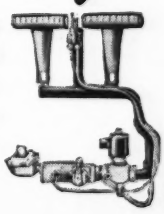

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TABLE 2

OIL LOSS DATA FOR LARGE HORIZONTAL SCRUBBER

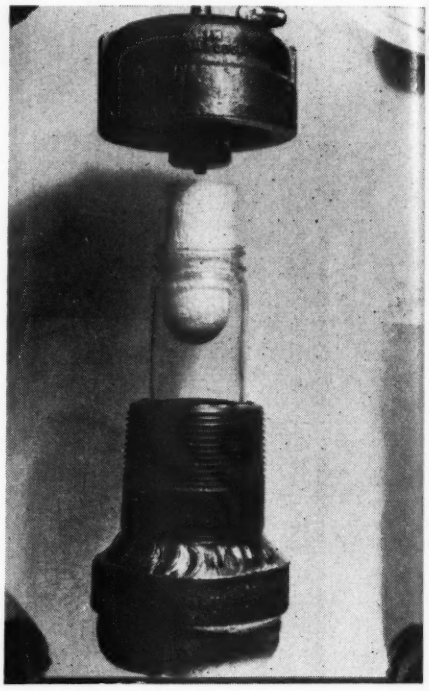
Gas Rate Through Scrubber MMcf per Hour	Average Operating Pressure, psig	Equivalent Gas Rate at 400 psig, MMcf/Hr	Oil Loss Gal./MMcf
1.0	343	1.08	0.0
2.0	339	2.16	0.0
2.5	425	2.43	0.0
3.0	409	2.97	0.085
3.0	343	3.23	0.075
3.5	405	3.48	0.205
4.0	400	4.0	1.66
4.0	360	4.21	1.59

TABLE 3

SUMMARY OF OIL LOSS DATA FOR VERTICAL SCRUBBER

Gas Rate Through Scrubber MMcf per Hour	Average Operating Pressure, psig	Equivalent Gas Rate at 400 psig, MMcf/Hr	Oil Loss Gal./MMcf
2.2	563	1.86	0.0
3.02	525	2.65	0.0
3.58	530	3.12	0.0
3.58	530	3.12	0.02
4.3	525	3.77	0.36
4.5	530	3.92	0.94

Fig. 10. Assembly of thimble and bottle in sampling cylinder. Bottle protects thimble from picking up dirt and collects any scrubber oil that might pass through paper filter.



tioned in the laboratory by extractions with distilled water and then solvent. Between each extraction the thimbles are dried in the oven. After the final drying in the oven the thimbles are allowed to cool in the room and then are placed in a dessicator for 15 minutes. The conditioned thimbles are then placed in a sealed bottle of known weight and weighed. The weight of the paper thimble is then determined from the difference in weight of the bottle with and without the thimble. Each thimble is transported to and from the field in the sealed bottle as shown in *Fig. 8;* and for a test, the bottle, with the cap removed, is placed in the thimble cylinder as shown in *Figs. 9* and *10*. The bottle serves to protect the thimble from picking up dirt by contact with the cylinder and also to collect any scrubber oil which might pass through the paper thimble. At the conclusion of a test the thimble and bottle are again weighed. Since a gain in weight of the bottle and thimble could represent both dust and oil, the oil is extracted and the thimble and bottle, after being dried, are again weighed to determine the weight of dust in the sample. A view of the thimble adaptor is shown in *Fig. 11*.

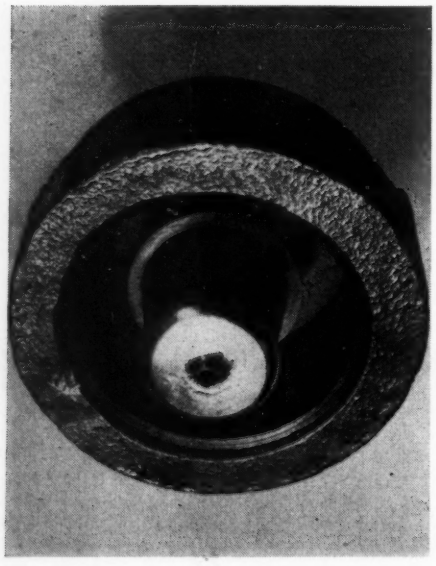


Fig. 11. View of sampling cylinder cap showing design of adapter for thimble. Thimble and bottle are both re-weighed after test, to determine oil-dirt presence.

Results of tests to determine the oil loss by mechanical entrainment from the small horizontal scrubbers, the large horizontal scrubbers, and the vertical scrubbers at different gas rates are shown in *Tables 1, 2,* and *3*, respectively. Operating pressures ranged from 257 psig to 425 psig during tests on the horizontal scrubbers and from 525 psig to 563 psig during tests on the vertical scrubbers.

Since the capacity of a scrubber varies directly as the square root of the absolute operating pressure, gas rates at the different operating pressures were converted to equivalent rates at 400 psig operating pressure. Curves showing the oil loss at different gas rates for the small horizontal scrubbers, the large horizontal scrubbers, and the vertical scrubbers are presented in *Figs. 12, 13,* and *14*, respectively.

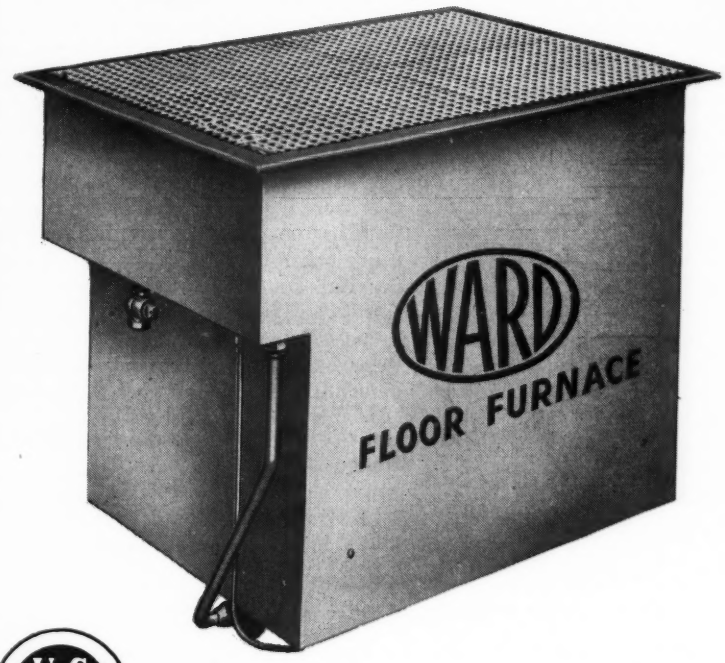
The selection of a maximum oil loss (by mechanical entrainment) as a basis for establishing scrubber capacity is arbitrary; however, it is generally desirable to keep the oil loss as low as possible, and some manufacturers of scrubbers and oil-gas separators guarantee

YOU'VE GOT A LOT OF

Talking Points

WHEN YOU FEATURE THE

WARD FLOOR FURNACE



Yes sir, when you stack the Ward up against other floor furnaces it stands out like a lighthouse by comparison. For example, it's *the only furnace on the market today with a stainless steel combustion chamber and 20-year guarantee.*

And—look at these other advanced features:

- **Bilt-in Thermo Control**
- **100% type safety pilot on automatics**
- **Heavy, close mesh fabricated register**
- **Brass screw-type lighter door**
- **Copper bearing, steel radiation chamber**
- **Copper nipple on draft diverter**
- **Asbestos vent tube insulator**
- **Asbestos insulated inner shell**
- **Asbestos insulated outer shell**
- **Slotted blue flame Bunsen burner**

USS STAINLESS STEEL — AMERICAN GAS ASSOCIATION — APPROVED

Write for 40 page catalog

showing Stainless Steel and Standard Lines —floor, dual, single register, and bathroom register models.

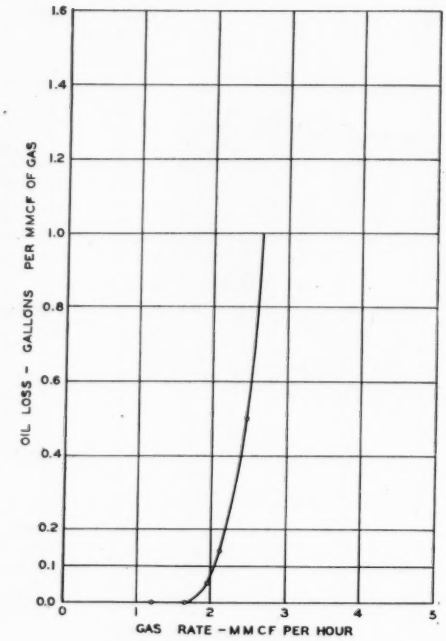
Easy installation and service, too—because of its new shallow construction and controls accessible from top of furnace. The new Ward is a better deal . . . both for you and your customers!

WARD HEATER COMPANY

Since 1909

1800 WEST WASHINGTON BOULEVARD • LOS ANGELES 7, CALIFORNIA

Fig. 12. Oil loss from small horizontal scrubber at different gas rates; 400 psig operating pressure.



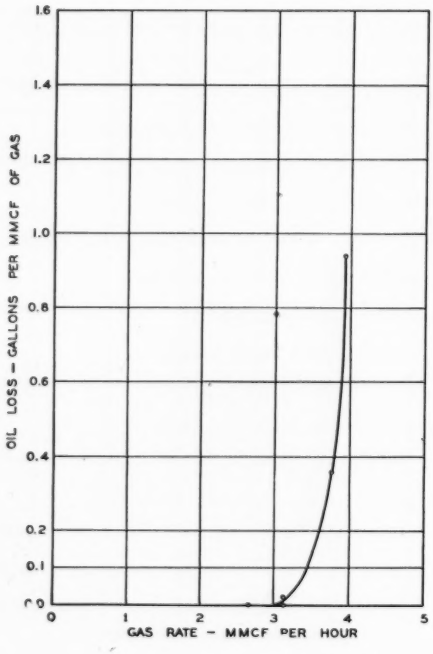


Fig. 14. Oil loss from vertical scrubber at different gas rates; 400 psig operating pressure.

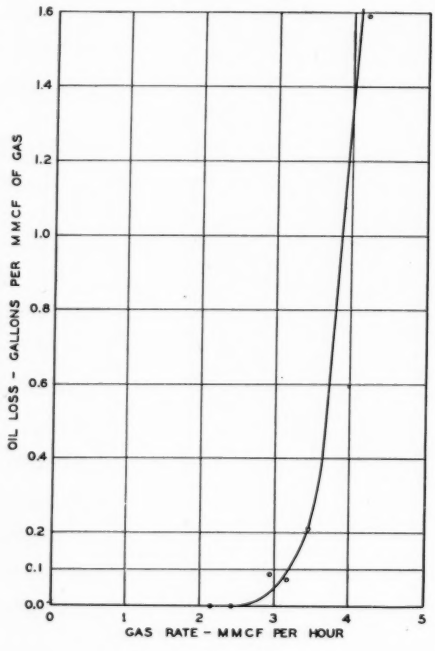
Fig. 15. Capacity curves for each of the vertical scrubbers.

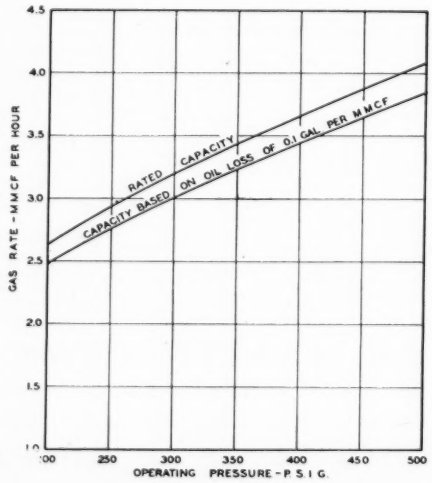
that the maximum oil loss from their equipment will not exceed 0.1 gal. per MMcf. For this reason, it was decided that a maximum oil loss of 0.1 gal. per MMcf would be used as the basis for determining the capacity of these scrubbers.

For a maximum oil loss of 0.1 gal. per MMcf at an operating pressure of 400 psig the capacity of the small horizontal scrubber is 2.03 MMcf per hr (see *Fig. 12)*, the capacity of the large horizontal scrubber is 3.2 MMcf per hr (see *Fig. 13)*, and the capacity of the vertical scrubber is 3.45 MMcf per hr (see *Fig. 14)*.

Curves showing the rated capacity, the capacity determined from pressure drop measurements, and the capacity based upon an oil loss of 0.1 gallons per MMcf, at operating pressures ranging from 200 psig to 500 psig are presented

Fig. 13. Oil loss from large horizontal scrubber at different gas rates; 400 psig operating pressure.





in *Fig. 6* (see *GAS*, August 1950) for the small horizontal scrubbers and in *Fig. 7* (see *GAS*, August 1950) for the large horizontal scrubbers. Curves showing the rated capacity and the capacity based upon an oil loss of 0.1 gal. per MMcf, at operating pressures ranging from 200 psig to 500 psig are presented in *Fig. 15* for the vertical scrubbers.

When the capacities determined from oil loss are compared with the rated capacities of the respective scrubbers it is found that the actual capacity of the small horizontal scrubber is 52% of its rated capacity, the actual capacity of the large horizontal scrubber is 52.5% of its rated capacity, and the actual capacity of the vertical scrubber is 94% of its rated capacity.

While the horizontal scrubbers were considerably overrated, the actual capacity of the large horizontal scrubbers is approximately 93% of the actual capacity of the vertical scrubbers.

When this test work was started it was planned to determine the efficiency of these scrubbers in removing dust as well as to determine their capacity. However, samples taken from the gas inlet lines to the scrubbers indicated that there is some oil and only a trace of dust in the gas. Apparently, sufficient oil is being carried in the lines to wet the wall of the pipe and prevent any significant concentration of dust from being carried in the gas stream. Under these conditions it was not feasible to determine the efficiency of these scrubbers in removing dust.

After the large horizontal scrubbers

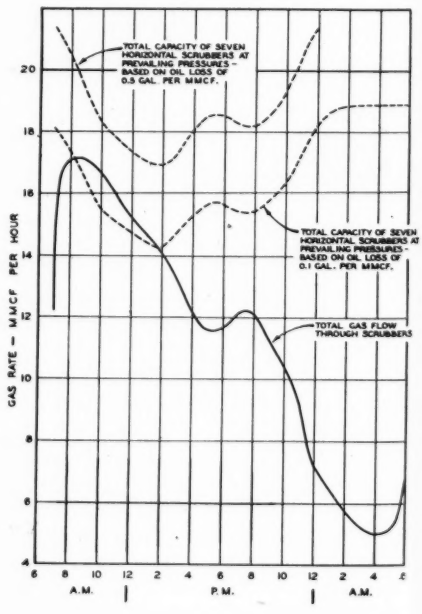

TOTAL CAPACITY OF SEVEN HORIZONTAL SCRUBBERS AT PREVAILING PRESSURES - BASED ON OIL LOSS OF 0.5 GAL. PER MMCF.
TOTAL CAPACITY OF SEVEN HORIZONTAL SCRUBBERS AT PREVAILING PRESSURES - BASED ON OIL LOSS OF 0.1 GAL. PER MMCF.
TOTAL GAS FLOW THROUGH SCRUBBERS
GAS RATE - MMCF PER HOUR
A.M.
P.M.
A.M.

Fig. 16. Curves showing relationship between total gas flow through horizontal scrubbers and total scrubber capacity during a typical day.

had been in operation for a short time at Santa Fe Springs it was found that the three large scrubbers generally showed a gain in oil level, whereas the four small scrubbers generally showed a loss. From February through June of 1949 there was an average monthly gain of 804 gal. of scrubber oil and an average monthly loss of 492 gal. of scrubber oil. Practically all of this gain was in the large scrubbers and practically all of the loss was from the small scrubbers. Upon completion of the tests to determine scrubber capacities, operating records for the horizontal scrubbers were inspected to determine if the actual capacities of these scrubbers were adequate to handle the gas load.

Plotting Gas Rates

Hourly gas rates and operating pressures during a typical day in April 1949, are shown in *Table 4*. These hourly gas rates have been plotted as shown in *Fig. 16*. A curve showing the total capacity of the seven scrubbers based upon an oil loss of 0.1 gal. per MMcf and a curve showing the total capacity of the seven scrubbers based upon an oil loss of 0.5 gal. per MMcf also are shown in *Fig. 16*. These capacity curves show how the total capacity of the scrubbers varies during the day as the operating pressure changes.

During this particular day there would have been oil loss in excess of 0.1 gal. per MMcf for approximately 5½ hours, if all of the scrubbers were operated at capacity, and at no time would the oil loss be as high as 0.5 gal. per MMcf.

However, upon further investigation it was found that all of the scrubbers were not operating at full capacity. The four small scrubbers were carrying about 56% of the load, whereas on the basis of the actual capacity they should have been carrying only about 46% of the load.

When the actual gas load on the small scrubbers was plotted along with capacity curves for the prevailing pressures, as shown in *Fig. 17*, it was found that the oil loss from the small scrubbers was in excess of 0.5 gal. per MMcf for approximately 5½ hours and in excess of 0.1 gal. per MMcf for approximately 8¾ hours during the day. The gas load on the three large scrubbers when plotted in relation to their capacity curves at the prevailing pressures, as shown in *Fig. 18*, never lost as much as 0.1 gal. per MMcf at any time during the day. Thus the overloading of the small scrubbers caused a large oil loss from these scrubbers, whereas the underloading of the large scrubbers permitted them to gain oil from the incoming gas.

TABLE 4

Total Gas Flow Through Horizontal Scrubbers During Typical Day in April

Time	Gas Rate Mcf per Hour	Operating Pressure, psig
7:00 a.m.	12,128	426
8:00	17,035	390
9:00	17,018	345
10:00	16,730	305
11:00	15,914	290
12:00	15,186	275
1:00 p.m.	14,671	265
2:00	14,164	260
3:00	13,251	275
4:00	12,149	298
5:00	11,648	315
6:00	11,610	315
7:00	12,130	306
8:00	12,140	306
9:00	11,299	318
10:00	10,392	345
11:00	9,187	390
12:00	7,113	426
1:00 a.m.	6,524	456
2:00	5,795	462
3:00	5,250	465
4:00	5,048	465
5:00	5,048	465
6:00	6,604	465

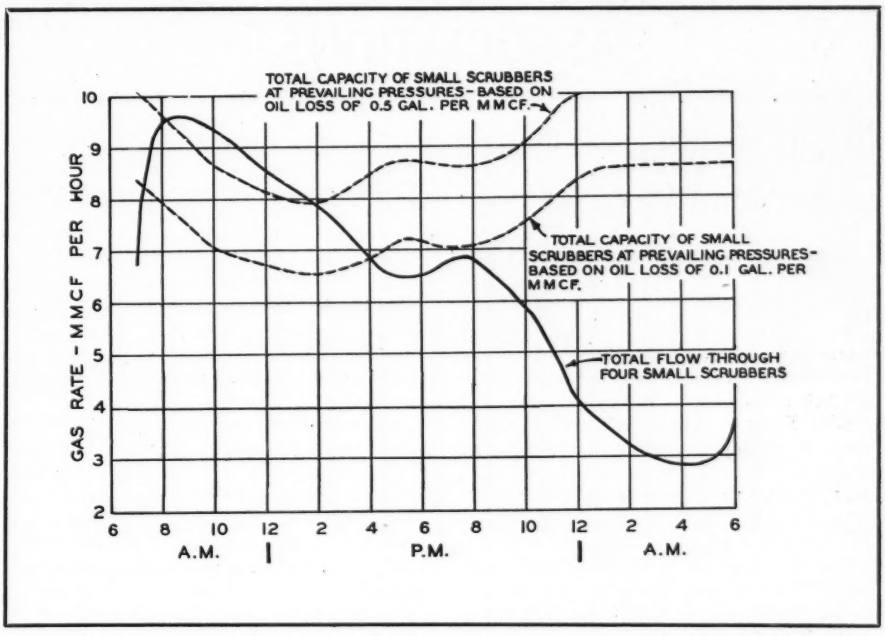

TOTAL CAPACITY OF SMALL SCRUBBERS AT PREVAILING PRESSURES - BASED ON OIL LOSS OF 0.5 GAL. PER MMCF.
TOTAL CAPACITY OF SMALL SCRUBBERS AT PREVAILING PRESSURES - BASED ON OIL LOSS OF 0.1 GAL. PER MMCF.
TOTAL FLOW THROUGH FOUR SMALL SCRUBBERS
GAS RATE - MMCF PER HOUR
10
9
8
7
6
5
4
3
2
6 8 10 12 2 4 6 8 10 12 2 4 6
A.M. P.M. A.M.

Fig. 17. Curves showing relationship between total gas flow through small horizontal scrubbers and scrubber capacity during a typical day.

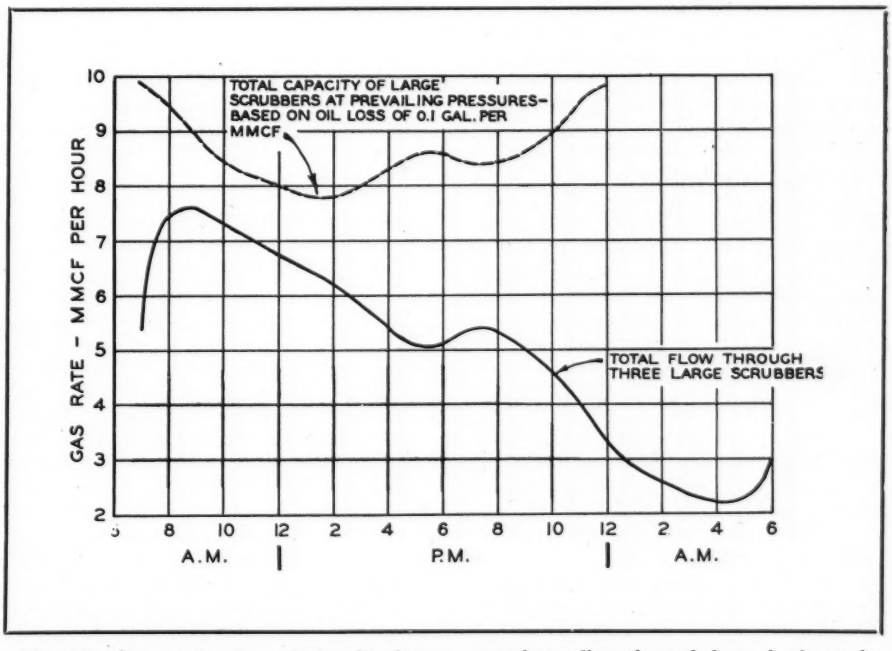


Fig. 18. Curves showing relationship between total gas flow through large horizontal scrubbers and scrubber capacity during a typical day.

ASSOCIATIONS

BRIGHT FUTURE

PCGA learns Seattle's hopes undimmed by war

A spirit of optimism over the possibilities of the Pacific Northwest's receiving natural gas in the near future prevailed at the 57th annual PCGA convention held early last month at Seattle.

With Ernest C. Manning, premier of Alberta, as the keynote speaker (see Pipeline section, p. 98), and with informal conversations centering about the brightened prospects of importation of natural gas, the sentiment of practically the entire 600 who attended was that, war or no war, chances are better than ever before.

The importance of the Pacific Northwest in the defense picture was felt to be a strong factor in favor of prompt action on the part of both Canadian and U. S. officials.

Despite the Korean war and the threat of future shortages, the theme of the convention centered about expansion and load building. How utilities elsewhere have built their loads and how the tempo of sales throughout the gas industry might be quickened were stressed in a number of key addresses.

The convention began with an unusual and highly effective dinner meeting which featured a skit titled "Paradise Lost—Paradise Regained," starring Miss Maxine Howe and W. Q. Kringle of Southern California Gas Co. and W. Darrell Milton of Southern Counties Gas Co., all of Los Angeles. The playlet demonstrated how a New Freedom gas kitchen can transform a housewife's duties. Miss Howe and Mr. Milton took the parts of a husband and wife and Mr. Kringle was the salesman who sold them a new kitchen. The skit effectively demonstrated gas' unbeatable advantages.

Formal opening of the convention came the following morning when N. Henry Gellert, president of Seattle Gas Co. and outgoing president of PCGA, soundly condemned the foreign policy of the U. S. and called for gas industry leadership in demanding a new, bold policy.

Following reports of section chairmen and of the nominating committee, Hugh Cuthrell, AGA president from Brooklyn Union Gas Co., and Stanley H. Hobson, GAMA president from Rockford, Ill., made strong pleas for more effective and aggressive salesmanship. Highlight of the noon luncheon which followed was the talk by Premier Manning, who was introduced by Gov. Arthur B. Langlie of Washington.

Sales again held the floor in the afternoon session when Harry K. Wrench, president of Minneapolis Gas Co., and George F. Mitchell, president of Peoples Gas Light & Coke Co., Chicago, spoke. Mr. Wrench, whose remarks are presented elsewhere in this issue, told the amazing story of how his company built its natural gas sales after its changeover. Mr. Mitchell presented a forceful case for conversion from cubic feet to therm rate well in advance of changeover to natural gas.

The role of regulation was introduced by Chairman Owen Clarke of the Washington Public Service Commission, who delivered a blistering attack on the FPC for its policy of expanding its jurisdiction until it overlaps that of state commissions. Mr. Clarke said, "The function of a public service commission is to protect the consumer against unreasonable and discriminatory rates. At the same time, we must also protect him against the possibilities of inadequate and inferior service."

Quoting from a report of the New York Public Service Commission, Mr. Clarke said, "'A very important fact regarding the expansion of facilities to meet the demands of applications for additional gas service has escaped the full attention it deserves. The cost of constructing additional generating, transmission, and distribution facilities is now very much greater than it has been for a whole generation. Utilities are required to make these expenditures in order to comply with the statutory requirement that adequate service must be provided . . . In unregulated competitive business a producer may refuse to expand if he thinks the investment at inflated prices is unjustified . . . The public utility has no option. It has a public duty to provide adequate service'."

Mr. Clarke also pointed out that the gas distributors in the Northwest "are still hanging on the ropes." The area must have natural gas, he said.

The following day was devoted to the social aspects of conventioneering as the delegates traveled by boat to Victoria, B. C. There a luncheon was served at the Crystal Gardens with introduction of past presidents of the association and the awarding of honors on the program. Gold medals were presented to J. L. Oberseider and J. S. Powell, both of Southern California Gas Co., for a paper on "Removal of Traces of Sulphur from Natural Gas" by Mr. Oberseider and two papers by Mr. Powell on odorants and odorization.

In the sales and advertising section the committee award was made to the range and refrigerator council chairmanned by F. N. Seitz of Southern Counties Gas Co. and Jim Graham of James Graham Manufacturing Co. Honor certificates went to P. R. Shea and R. M. Crosby of SoCal. An honorable mention to the home service committee was also given, presentation being made to Miss Phyllis Snow of Mountain Fuel Supply Co., Salt Lake City.

R. O. Montrief, Ward Heater Co., chairman of the heating division of the manufacturers section, was given honorable mention for work on "installation practices for heating appliances." The Basford trophy, given annually to the section accomplishing the most valuable work, was given to Jack L. Hall, SoCal, chairman of the sales and advertising section.

The final session featured the premier of Pacific Gas & Electric Co.'s color motion picture, "The PG&E Super Inch." Joseph Muckley, Seattle First National Bank, spoke on financing utility expansions in the Northwest, and K. W. Stookey, president of the Gas Machinery Co., Cleveland, told how high-Btu oil gas can be applied for interim use in natural gas standby.

Final event on the program was the installation of officers headed by Ernest C. Lawson, Pacific Public Service Co., San Francisco, who is taking over as new president. Sectional officers not listed in last month's *GAS* include Grove Lawrence, SoCal, chairman of the technical section; Walter E. Lind, PG&E, San Francisco, chairman of the sales and advertising section; C. G. Waters, San Diego Gas & Electric Co., chairman of the accounting section; and Thomas T. Arden, General Controls Co., chairman of the manufacturers section.

350 Expected at 35th Annual New Jersey Gas Meeting

About 350 gasmen are expected to attend the 35th annual meeting of the New Jersey Gas Assn., which will be held in Spring Lake Sept. 8.

Two sessions—morning and afternoon—will be held during the meeting. The two gatherings will be separated by a luncheon in the main dining room of the Monmouth hotel.

Speakers scheduled for New Jersey's meeting include Robin D. McNeice, utilization engineer, Public Service Electric & Gas Co., Newark; G. Edward Pendray, Pendray & Leibert; J. P. Leinroth, gas sales manager, Public Service Electric & Gas; Arthur Secord, Brooklyn college; Hall M. Henry, NEGEA Service Corp., Cambridge, Mass.; and Rob Roy Mcleod, vice president, Niagara Falls Power Co., Buffalo, N. Y.

Old Stove Round Up To Go On as Scheduled

The AGA - GAMA - sponsored Old Stove Round Up will proceed according to original plans, according to an announcement by Frank C. Smith, chairman of the general promotional planning committee, last month.

The uncertainty present among gas range manufacturers earlier in the month as to their ability to supply all the ranges required for the Round Up program has apparently been resolved. In making his announcement, Mr. Smith expressed the hope that gas utilities will cooperate fully with the general promotional planning committee and will not reduce efforts in local selling and advertising because of the earlier momentary hesitation on the part of manufacturers.

The promotional plans for the Round Up are completed, and campaign portfolios and other materials are already in the hands of gas companies and manufacturers.

Committee Studies Steel Needs

The National Petroleum council has announced formation of a committee on petroleum industry steel requirements and has named six subcommittees to study steel needs for all phases of the oil and gas industry.

Russell B. Brown has been named chairman of the NPC committee. He is also a general counsel of the Independent Petroleum Assn. of America.

The new committee and its six sub-units will survey steel needs for production, refining, marketing, transportation, and natural gas transmission, Mr. Brown said.

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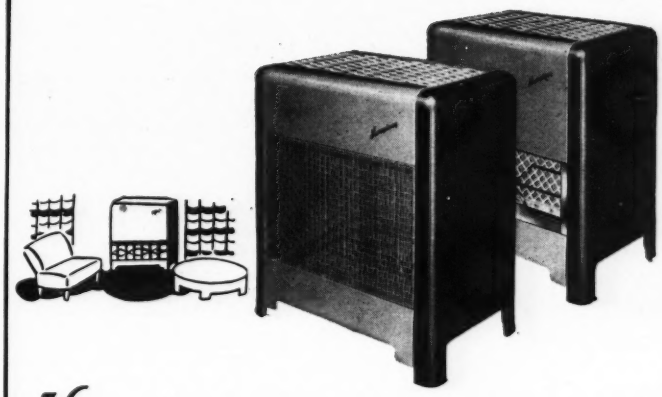
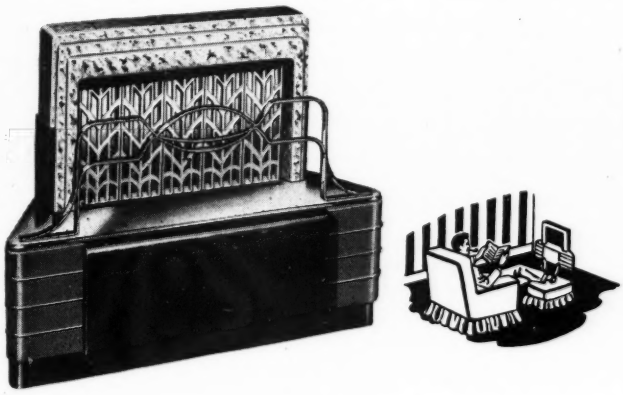


Humphrey **CIRCULATORS** Unsurpassed in ability to produce fast, clean heat . . . modern, beautiful styling . . . low cost operation. Two models . . . Open front Radiantfire Circulators and Closed front Royaline Circulators. Manual or automatic operation.



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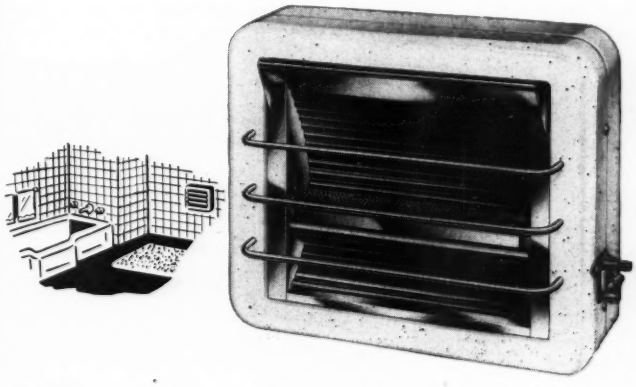

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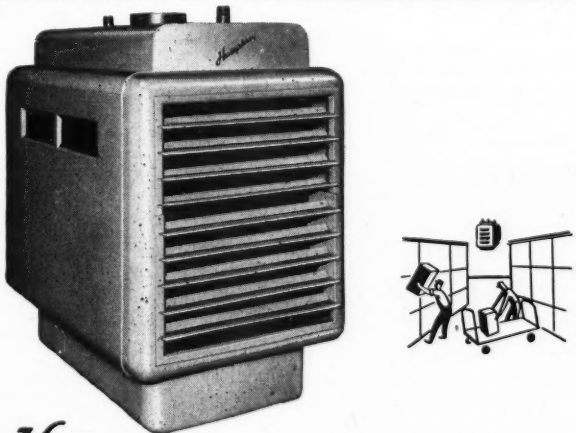

Humphrey **AUTOMATIC GAS UNIT HEATERS** Completely "packaged" circulated heat for stores, shops, restaurants, garages, factories, etc. No boiler room equipment or fuel storage. Exclusive Humphrey construction assures maximum heat output at lowest fuel cost. A size for every need.

There is no substitute for experience. For more than fifty years we have been designing and building gas heating equipment *exclusively* . . . that is why there is no finer line of gas heating equipment made.

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GENERAL GAS LIGHT COMPANY

KALAMAZOO, MICHIGAN

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225 Eleventh St., San Francisco

ABOVE: E. G. Lawson (left), Pacific Public Service Co., San Francisco, and new PCGA president, poses with Ernest C. Manning, premier of Alberta.

ABOVE, RIGHT: (left to right), F. W. Copp, Northwest Natural Gas Co., New York; A. Faison Dixon, Northwest Natural; R. E. Clarke, Standard Oil of California, San Francisco.

RIGHT: (left to right), Ivan Bloch, engineer-consultant, Portland, Ore.; Ray Fish, Fish Constructors Inc., Houston; Joseph Daniels, University of Washington, Seattle; and K. W. Stookey, Gas Machinery Co., Cleveland.

Camera Closeups at the PCGA Seattle Convention

LEFT: C. F. GUEFFROY (left), Portland (Ore.) Gas & Coke Co., with Harry K. Wrench, Minneapolis Gas Co.

BELOW, LEFT: (left to right), W. D. Milton, Southern Counties Gas Co., Los Angeles; Maxine Howe, Southern California Gas Co., Los Angeles; and W. Q. Kringle, SoCal.

BELOW: (left to right), W. F. Rockwell Jr., Rockwell Manufacturing Co., Pittsburgh, Pa.; Clifford Johnstone, PCGA; and Grove Lawrence, SoCal.

AGA Drafts Meaty Program For October Convention

Plans for the American Gas Assn. annual convention in Atlantic City in October are progressing rapidly, according to Hugh H. Cuthrell, president.

Mr. Cuthrell last month announced the appointment of James S. Moulton, Pacific Gas & Electric Co., San Francisco, as chairman of the distinguished service award committee. Awards presented by the committee consist of a certificate and a monetary prize and are made annually by the association to individuals judged to have made the most outstanding contributions toward advancement of the industry.

The AGA convention will be held from Oct. 2 to 6 in Atlantic City. As in the past, the Gas Appliance Manufacturers Assn. will hold its exhibition of appliances and equipment concurrently with the AGA meeting—the show will be held in the Atlantic City auditorium Oct. 5 and 6. GAMA has also announced a dealers' merchandising program starting Oct. 5.

The northeastern and southeastern districts of the Liquefied Petroleum Gas Assn. have also scheduled a joint meeting for Oct. 5 and 6 in Atlantic City, concurrent with the AGA conclave. The LP-Gas men will meet in the Ambassador hotel.

Program plans have been announced by George E. Whitwell, Philadelphia Electric Co., chairman of the general convention committee.

At a joint meeting of the manufactured and natural gas departments Oct. 2, problems of introducing natural gas into manufactured gas systems and fuel sources of the nation will be discussed.

Hugh H. Cuthrell, AGA president, will open the first general session which will include addresses by Harold E. Stassen on selling free enterprise, and James K. Polk, New York attorney, on Social Security. Tuesday's general session will feature "The Contribution of Business Management to the General Welfare" by Otto Seyferth. president, U. S. Chamber of Commerce. and "Standing Still or Going Ahead" by W. G. Strathern, Eastern Gas & Fuel Associates. W. Paul Jones, Servel president, and Stanley Hobson, president of GAMA, will also speak.

Sectional meetings and activities are scheduled for Tuesday afternoon, Oct. 3 and, in addition, the residential gas and industrial and commercial gas sections will hold a joint session the morning of Oct. 4.

Hotel Traymore's American dining room will be the scene of the Home Service Breakfast Oct. 4. Irene L. Muntz, committee chairman, will preside. At an employee relations session sponsored by the personnel committee, Dr. Robert K. Burns, University of Chicago, and Dr. John J. Wittmer, Consolidated Edison Co., will be featured speakers.

CALENDAR

SEPTEMBER

New Jersey Gas Assn. Annual Convention—Monmouth hotel, Spring Lake, N. J., Sept. 8.

National Petroleum Assn.—Hotel Traymore, Atlantic City, Sept. 13-15.

Mid-West Gas Assn. 27th Gas School & Conference—Iowa State College, Ames, Sept. 14-15.

Controllers Institute of America Annual Meeting—Edgewater Beach hotel, Chicago, Sept. 17-20.

The Maryland Utilities Assn.—Cavalier hotel, Virginia Beach, Va., Sept. 22-23.

Case Institute of Technology Corrosion Short Course—Cleveland, Ohio, Sept. 25-29.

OCTOBER

AGA Annual Convention and GAMA Exhibition of Gas Appliances and Equipment—Atlantic City, N. J., Oct. 2-6.

Texas Mid-Continent Oil & Gas Assn. Convention—Dallas, Oct. 4-5.

National Safety Congress & Exposition—Chicago, Oct. 16-20.

Independent Natural Gas Assn. of America Annual Meeting—Shamrock hotel, Houston, Oct. 23.

National Metal Exposition—Amphitheatre, Chicago, Oct. 23-27.

Natural Gasoline Assn. of America Southern Regional Meeting—Blackstone hotel, Tyler, Texas, Oct. 27.

NOVEMBER

National Hotel Exposition—Grand Central Palace, New York, Nov. 6-10.

Wisconsin Utilities Assn. Gas & Electric Section Convention—Schroeder hotel, Milwaukee, Nov. 8-10.

Mid-Southeastern Gas Assn.—The Sir Walter hotel, Raleigh, N. C., Nov. 9-10.

American Petroleum Institute Annual Meeting—Los Angeles, Calif., Nov. 13-16.

New Jersey Utilities Assn. Annual Meeting—Seaview Country Club, Absecon, N. J., Nov. 17-18.

American Society of Mechanical Engineers Annual Meeting—Hotel Statler, New York, Nov. 26-Dec. 1.

AGA-SGA Employee Relations Conference—New Orleans, Nov. 27-28.

DECEMBER

The American Society of Refrigeration Engineers—Hotel Commodore, New York, Dec. 3-6.

Institute of Cooking and Heating Appliance Manufacturers Semi-Annual Meeting—Cincinnati, Dec. 4-6.

JANUARY 1951

AGA Home Service Workshop—Hotel Statler, Washington, D. C., Jan. 3-5.

Pipe Line Contractors Assn. Annual Convention—Shamrock hotel, Houston, Jan. 9-10.

MARCH

Mid-West Gas Assn.—Hotel Fontenelle, Omaha, March 12-14.

National Assn. of Corrosion Engineers Conference & Exhibition—Hotel Statler, New York, March 13-16.

Gas Appliance Manufacturers Assn. Annual Meeting—The Homestead, Hot Springs, Va., March 19-21.

New England Gas Assn. Annual Meeting—Hotel Statler, Boston, March 29-30.

APRIL

AGA Sales Conference on Industrial & Commercial Gas—Shoreham hotel, Washington, D.C., April 2-4.

Mid-West Regional Gas Sales Conference, Residential Gas Section—Edgewater Beach hotel, Chicago, April 9-11.

Southwestern Gas Measurement Short Course—University of Oklahoma, Norman, April 10-12.

AGA Distribution, Motor Vehicle, and Corrosion Conference—Hotel Peabody, Memphis, April 16-18.

Southern Gas Assn. Annual Meeting—Biloxi, April 23-25.

National Conference of Electric and Gas Utility Accountants—Hotel Sherman, Chicago, April 23-25.

Indiana Gas Assn.—French Lick Springs, French Lick, Ind., April 26-27.

AGA Industrial & Commercial Gas Section, Industrial Gas School—William Penn hotel, Pittsburgh, April 29-May 4.

MAY

AGA Natural Gas Department Spring Meeting—Dallas, May 7-8.

Pennsylvania Gas Assn.—Wernersville, Pa., May 14-16.

AGA Production and Chemical Conference—Hotel New Yorker, New York, May 14-16.

Public Utilities Advertising Assn. Convention—Hotel New Yorker, New York, May 17-19.

JUNE

Institute of Cooking and Heating Appliance Manufacturers Annual Meeting—Cincinnati, June 5-6.

Canadian Gas Assn.—Bigwin Inn, Lake of Bays, Ontario, Canada, June 18-21.

Safety Men Gather This Month

AGA's accident prevention committee has announced plans for a fall safety conference to be held at the Wardman Park hotel in Washington, D.C., Sept. 18-20.

Under Chairman E. J. Kennelly, Texas Eastern Transmission Corp., the program committee has planned a safety information program including these general categories: the accident prevention committee's responsibility to the gas industry; correlating safety efforts on a national scale; practical safety during changeover from manufactured to natural gas; safe excavation of city streets; equipment and training for fire fighting; and statistical studies of consumer and employee accident frequencies.

NEW PRODUCTS

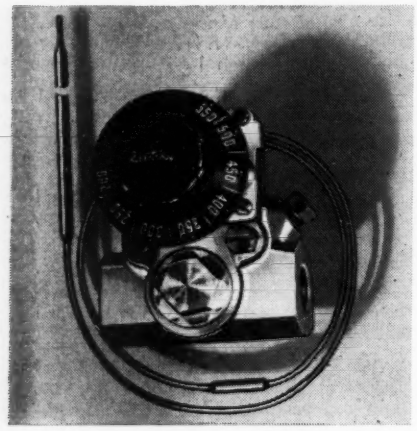
Range Control

ROBERTSHAW THERMOSTAT DIVISION, Robertshaw-Fulton Controls Co., Youngwood, Pa.

MODEL: DG hydraulic throttling type control.

APPLICATION: For commercial cooking equipment.

DESCRIPTION: This control embodies the standard Robertshaw diastat. It features fast



opening when set at the top of temperature ranges, has unusually large capacity for its size, is compensated for ambient temperature up to 350°, and is available only with high temperature equipment diastat. The new design eliminates the gland pin while providing all front adjustments for recalibration, pilot and bypass, removing valve and cleaning valve seat. The diastat can be removed and replaced without disconnecting body.

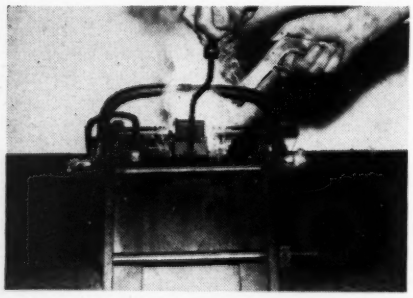
Bonding Kit

DRESSER MANUFACTURING DIVISION, Dresser Industries Inc., Bradford, Pa.

MODEL: Dresser-Bond.

APPLICATION: For bonding mechanical couplings on steel pipelines.

DESCRIPTION: The kit consists of 50 pre-



formed bonds, welders, flint gun, flash powder, metal discs and coating compound for completing 50 bonds. A five-second chemical welding method which any workman can use is employed.

Advantages claimed over other methods are these: Resistance of the bond is low and it retains its bonding properties permanently because a homogeneous weld area is attained and all surface control variables are eliminated. There is no danger of burning the copper wire, pipe, or inside pipe coating. There are no dangerous fumes and no heavy equipment to handle. No training or special skills are required to effect permanent bonds. Overall cost savings are estimated at as high as 50% over other bonding methods.

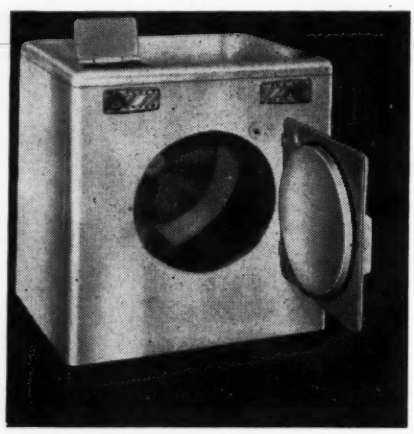
Clothes Dryer

TEMCO INC., Nashville, Tenn.

MODEL: Clothes dryer with Sun Dial control.

DESCRIPTION: The Sun Dial is the only control on this dryer. A sensitive element within the machine detects when clothes are almost ready, and an economizer switch turns off the heat while permitting the tub to revolve five minutes longer, thus finishing the cycle with stored heat and bringing the clothes to a temperature comfortable for handling.

A reversible lint trap permits either the venting of moist air to the outside or the



conventional method whereby discharge is made into the laundry area. The machine comes fully equipped for this dual operation. An inspection door with operating instructions mounted on the inside is located in the top.

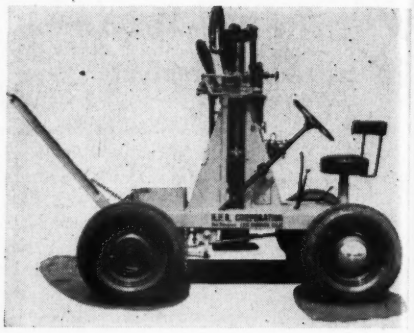
This automatic unit requires 15,000 Btu per hour. An average load may be fluff-dried in 35 to 40 minutes.

Pavement Breaker

R.P.B. CORP., 2751 E. 11th St., Los Angeles 23, Calif.

MODEL: Mighty Midget Model B.

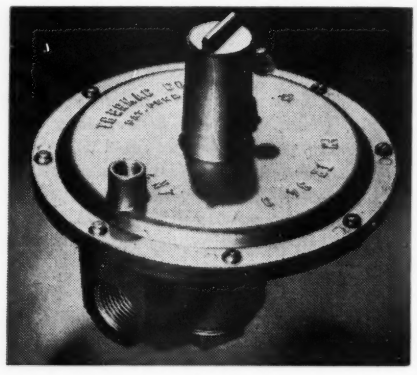
DESCRIPTION: This model is automatically controlled and, the manufacturer states, thus eliminates most of the upsurge of the piston against the top head and 95% of the over-reach on the bottom head. A 200-lb head gives a more effective blow, especially in cutting asphalt. The machine is equipped with a conventional automobile rear end, driving on both wheels. It is also equipped with an automatic attachment as shown in



the picture, with the auxiliary cylinder standing parallel to the main cylinder. Overall dimensions are length, 87 in.; width, 65 in.; and height, 78 in.

Regulator

THERMAC CO., 800 E. 108th St., Los Angeles 2, Calif.



MODEL: TR ¾-D low-pressure appliance regulator.

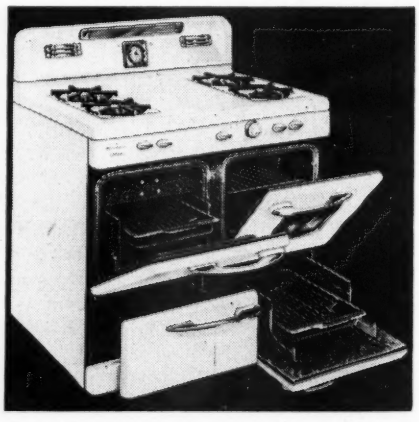
DESCRIPTION: This model measures 6 in. in diameter and replaces the TR-30 and TR-40. It is made in the following sizes and capacities: ¾-in.—175,000 Btu/hr minimum; 1-in.—200,000; 1½-in.—250,000.

Ranges

CALORIC STOVE CORP., 1242 Widener Bldg., Philadelphia 7, Pa.

MODELS: W-7428-UX (illustrated), 7328-UX, 7618-UX, and 7698-U.

DESCRIPTION: The illustration shows a 40-in., four-burner divided top model with elevated broiler on the left and extra broiler



To Meet Competition's Challenge

THE gloves are off in the competition for public preference. How are you meeting the challenge?

The best answer to competition is a fully informed, confident personnel—fully informed on the newest techniques and developments, methods and appliances, processes and equipment that make Gas the finest service money can buy. *To be sure your personnel is fully informed*

Send them to the

A.G.A. Convention and G.A.M.A. Exposition

Atlantic City

OCT. 2-6

THE GAS INDUSTRY'S MID-CENTURY PAGEANT OF PROGRESS

Here they can participate in a timely and constructive program that will discuss every phase of the manufacture, distribution and sale of Gas. Here, under one roof, they can see a complete exhibit of the most modern home appliances, machinery and methods.

Here they can discuss their own problems with the keenest minds in the Industry.

Send your personnel to Atlantic City, Oct. 2-6 and you'll be sure to meet competition's challenge to *you* with a fully informed, an inspired, a *confident* organization.

GAS APPLIANCE MANUFACTURERS ASSOCIATION, INC.

below oven. Model 7328-UX is a 30-in., four-burner divided top range; the other two models are 36-in., four-burner types, the latter including an arrangement for kitchen heating with an automatic thermostat to control room temperature.

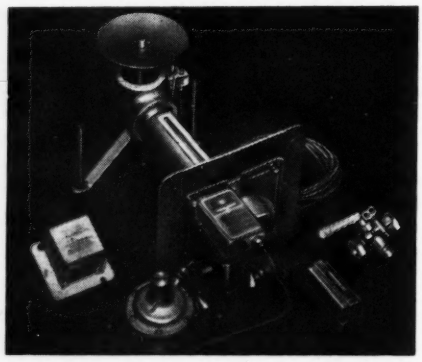
Conversion Burner

MODERN CONTROLS CORP., 7620 Kercheval St., Detroit.

MODEL: Monoport.

APPLICATION: For converting oil-fired or coal-fired heating systems for steam, warm air, or hot water.

DESCRIPTION: Models 175-A & B have



an input range from 50,000 to 175,000 Btu per hour for natural or mixed gases. Models 300-A & B have a 50,000- to 300,000-Btu input range for the same gases and up to 250,000 Btu per hour for manufactured gases. Available with either Minneapolis-Honeywell or White-Rodgers controls.

Range

DETROIT - MICHIGAN STOVE CO., Detroit 31, Mich.

MODEL: Garland "Dinette."

APPLICATION: For fountains, diners, taverns, and small-volume food-serving establishments.

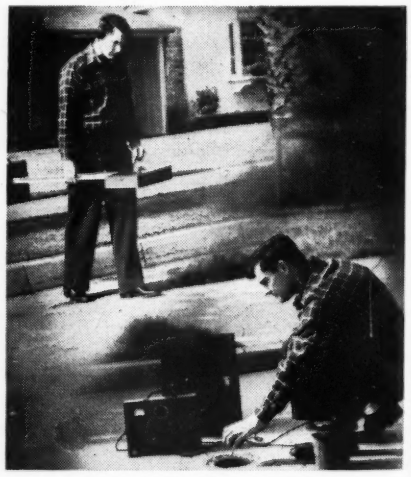
DESCRIPTION: Compact in design, the Dinette features a full-size oven, large

broiler and griddle, four top burners, ample storage space, and convenient drip trays. Both the stainless steel and the black porcelain finish models are available with or without a high shelf. It is equipped for use with natural, manufactured, or LP-Gases.

Locator-Detector

THE GOLDAK CO., 1542 W. Glenoaks Blvd., Glendale, Calif.

MODEL: Dualtronic combined pipe locator and leak detector.



DESCRIPTION: This multi-purpose electronic instrument is easy to handle, light in weight, and is said to be inexpensive to operate. It does the work of two instruments and saves labor.

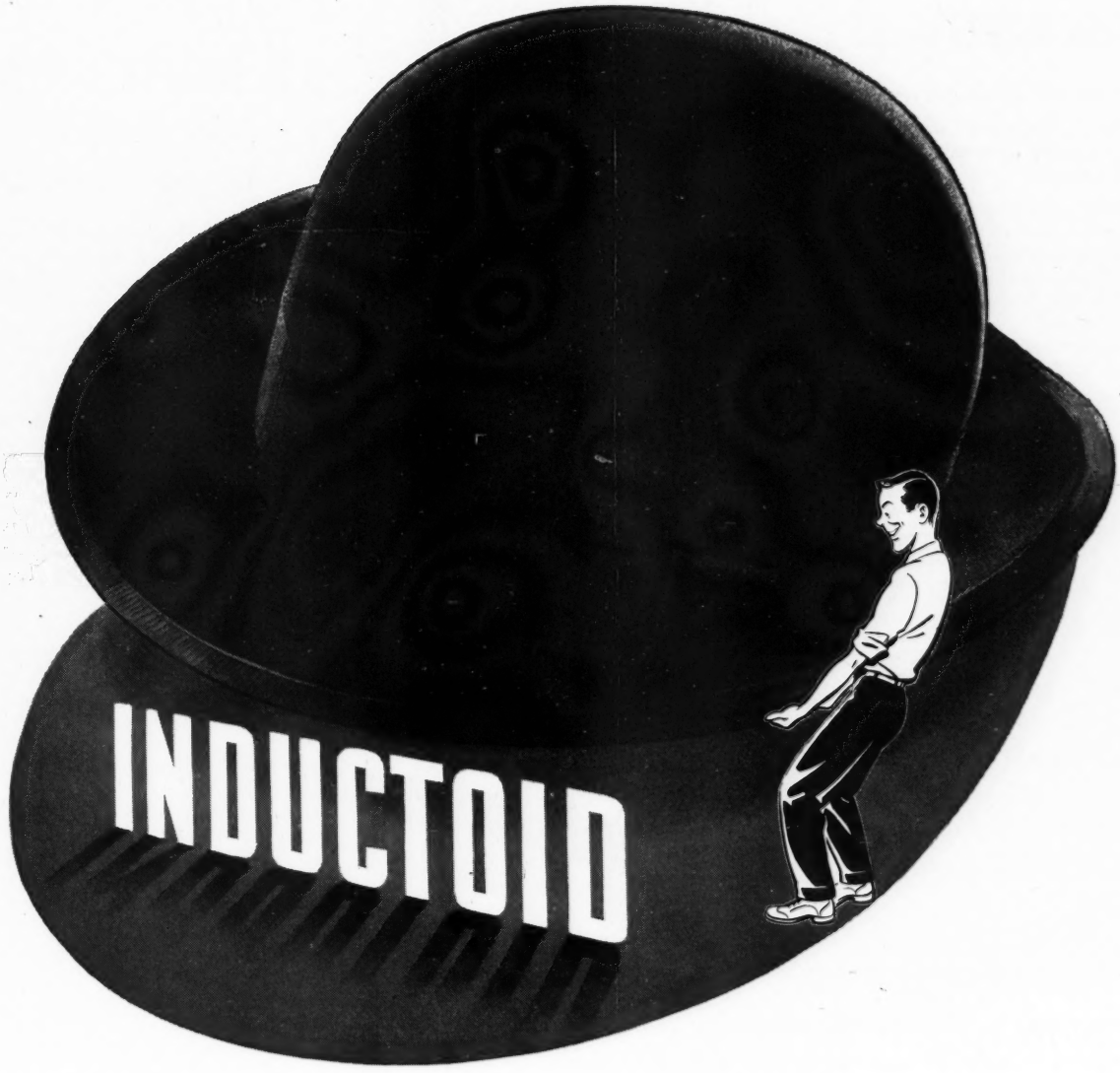
for over 25 years
WORKING WITH THE GAS INDUSTRY

Gas men know CLEVELANDS mean dependable scheduling and dependable performance because CLEVELAND engineering has kept pace with gas trenching problems. Compact design and hairline controls solve the problems of crowding city obstructions. Full-crawler mounting with smooth pads protects walks and lawns. CLEVELANDS ruggedness sets you up for the toughest off-season digging, while CLEVELANDS mobility and built-in higher capacity guard close deadlines on short, scattered jobs. Write today for details or see your local distributor.

Baby Digger "92" loads on or off its tilt-bed "T-5" trailer in 5 minutes flat.

See "CLEVELAND" at A. G. A. CONVENTION Atlantic City, Booths 713-714 Also at "The Ambassador" Rooms 409-412

THE CLEVELAND TRENCHER CO.
20100 ST. CLAIR AVENUE • CLEVELAND 17, OHIO



a coming event casts its shadow before

It's been kept strictly "under the hat" until now—this entirely new and revolutionary product for the gas industry! It's called *Inductoid*. And you will get the first look—when Milwaukee Gas Specialty Co. brings it out—at the G.A.M.A. Convention, in October, at Atlantic City. Go straight to Booth 521—don't miss it.

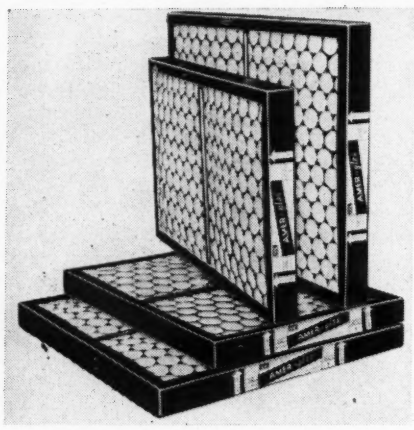
Air Filter

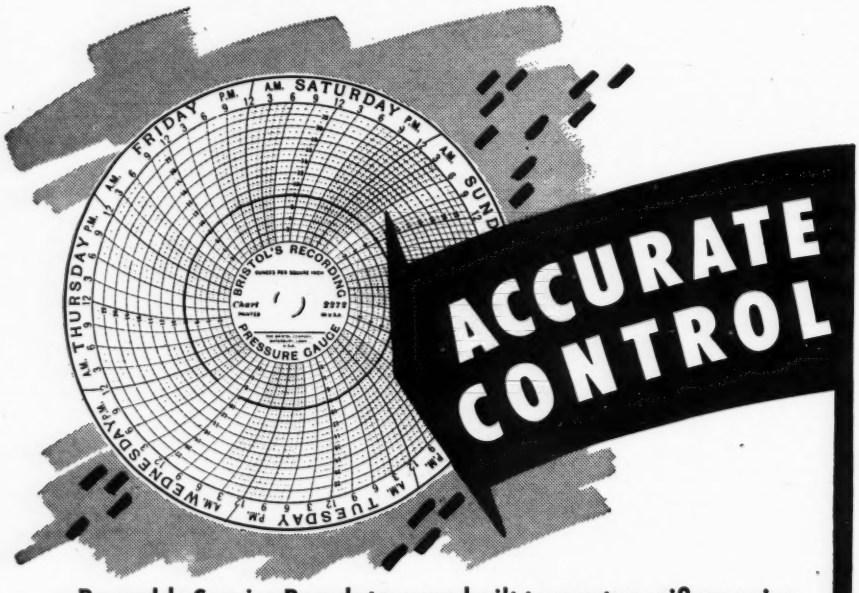
AMERICAN AIR FILTER CO. INC., Louisville 8, Ky.

MODEL: Amer-glas replaceable type filter.

APPLICATION: Made in all standard sizes for forced air heating or ventilating and air conditioning systems.

DESCRIPTION: The filtering medium consists of continuous strands of glass filaments held together at each point of contact by a high-temperature plastic bond to form a resilient pad. The pad is sprayed with an odorless and non-flammable adhesive and placed in a fiberboard casing between metal grills. Bulletin No. 211 gives further details.





Reynolds Service Regulators are built to meet specific requirements — years of operation in the field through a complete range of operating conditions have proved not only their superiority but their durability. With parts so precisely machined for each model that they are completely interchangeable. The accuracy you require in performance is assured.

MODEL 10

Dead Weight or Spring Type, with or without Mercury Seal, or Dead Weight Safety Seal or diaphragm operated relief valve. All working parts are so accessible as to be interchangeable without removal from pipe line.

MODEL 20

Dead Weight or Spring Type, with or without Mercury Seal, or Dead Weight Safety Seal or diaphragm operated relief valve. All working parts are so accurate as to permit complete interchangeability in shop.

MODEL 30

For horizontal or vertical connections, with or without removable valve pocket. Available with either Spring or Dead Weight adjustment. With or without Mercury or Dead Weight Safety Seal or diaphragm operated relief valve.

Reynolds Gas Regulator Co.
ANDERSON, INDIANA, U. S. A.

GAS CONTROL SINCE 1892

SALES and PROMOTION

1.15 MILLION HEATERS

AGA survey verifies big market prediction

Further indication that 1950-51 will be the biggest gas heating season ever, as first predicted in a *GAS* survey of utilities published in the July Heating Issue, was given last month when the American Gas Assn. published results of its own survey showing that utilities throughout America expect to add 1,150,000 househeating customers to their lines for the next heating season.

Carrying the projections a bit farther, the AGA study set up a probable total of 3 million new customers in the next three heating seasons.

The AGA's crystal gazers perceived even more optimism than did the *GAS* editors, who conservatively estimated a round 1 million new heating customers. AGA's sampling covered 295 utilities serving 19,240,000 residential customers—90% of the nation's total. Thus, with such broad coverage, the association's figures would appear to be an accurate reflection of industry-wide trends.

From its 90% returns, AGA projected 1,013,141 anticipated sales by the 295 companies in 1950-51 to 1,150,000 for the entire industry; 852,000 additions in 1951-52 to 950,000; and 774,452 in 1952-53 to 900,000.

If utility dreams come true, 9.4 million customers will be heating with gas next winter—more than 40% of the total residential load.

Allocation of new additions between new construction and conversions stand about 50-50, the AGA reported.

Winners for First Half of "Big Six" Contest Listed

With the second half of the contest now nearing the final day, winners for the first half of the "Big Six" gas refrigeration sales contest were announced last month by the gas refrigeration committee of the Residential Gas Section of the AGA.

For the initial phase, which carried through the months of April, May, and June, Servel Inc. has handed out awards to gas companies, distributors, distributors' salesmen, dealers, retail salesmen, and apartment salesmen making the most sales per 1000 meters in each of the six regions of the United States. At the close of the "Clean Sweep" half of the contest Sept. 10, additional plaques, cash awards, a trophy, and an expense-paid vacation flight will be presented to winners.

Utilities who led their respective regions included Newport (R.I.) Gas Co., Manufacturers Light & Heat Co., Waynesboro, Pa.; Mississippi Gas Co., Meridian; Central Illinois Light Co., Springfield; Southern Union Gas Co., Galveston, and Southern Union's Carlsbad, N. Mex., branch.

By regions, the top men, winners of $150, were R. C. Barraca, Boston Consolidated; Jack Fisher of Jack Fisher Inc., Charleston,

HARDWICK ads will back your own

JUDGE COOKING PERFORMANCE BY JUST 3 THINGS—

Why pay for extras?

1. **PERFECT TOP-BURNER COOKING — INSTANT, ACCURATE, VISUAL CONTROL**

No boil-overs, no burn-drys, no pot-watching. Hardwick Simmer-Center burners are actually two burners in one — one for high-speed boiling and frying, one for keep-boiling and keep-warm heats — both fully adjustable and visual. Removable for easy cleaning at the sink.

2. **PERFECT BAKING WITH A BALANCED HEAT OVEN**

No turning or shifting of baking pans, no basting, no peeking. Heat in a Hardwick oven is perfectly balanced anywhere in the oven. There are no hot spots, no cold spots. Every cake browns perfectly — top and bottom.

3. **PERFECT BROILING WITH A LIVE-FLAME BROILER**

Positively smokeless. The live flame of a gas broiler is the most perfect for broiling all meats. Keeps your kitchen clean and smoke-free. And a Hardwick broiler is as easy to clean as any pot or pan — remove it, wash it in the sink.

You see gas stoves offered for almost nothing. Again you see them offered for almost a fortune. Which should you buy? Remember there are just *three* things that are important to you: the top burners, the oven and the broiler. Gadgets and fancy trimmings that increase the price can't improve the cooking performance. Hardwick Ranges are modern, beautiful, streamlined, without unnecessary extras. That's why the price is sensible and reasonable. Compared to expensive ranges, a Hardwick may save you enough for an additional gas appliance to make homemaking easier. And you can't buy better cooking performance, no matter what you pay.

See your dealer, your gas company, or write to Dept. P-1

GAS HAS GOT IT!

MODEL NO. 5516-1

Old Stove Round-up Time

Trade your old stove NOW!

HARDWICK
AUTOMATIC GAS RANGES

HARDWICK STOVE COMPANY
Established 1879
CLEVELAND, TENNESSEE

Strong Promotion Story

National advertising will give you a merchandising natural — the promotion of two appliance sales instead of one. Hardwick emphasizes the advantages of gas, stresses cooking results, at a price your customers can afford.

See—
McCALL'S
BETTER HOMES & GARDENS
THE LADIES' HOME JOURNAL
THE SATURDAY EVENING POST

Here's a merchandising plan made to order for your own promotion program. Point out to your customers that her saving on a Hardwick, compared to many ranges that cost far more, is enough to buy a new automatic gas water heater or some other gas appliance. You get top appliance volume, greater customer satisfaction, and a larger gas load. Write for details and tie-in materials.

SEE HARDWICK'S EXHIBIT AT THE A. G. A. CONVENTION IN ATLANTIC CITY, OCTOBER 2 - 6

HARDWICK STOVE COMPANY - CLEVELAND, TENNESSEE

A SIMPLE SOLUTION for one of the GAS INDUSTRY'S *most trying problems*

the **NORMAC**

BELL JOINT CLAMP

SOLVES YOUR JOINT REPAIR PROBLEMS

6 inch Normac Clamp being lowered into hole for installation

6 inch Normac Clamp in service after installation

QUICK • EASY • PERMANENT

Installed in small pavement openings. Available in all standard sizes from 3" to 12". A simple set of tools cleans the joint, installs the clamp . . . often in only a quarter of an hour. SAVES TIME. SAVES MONEY and the repair is permanent. Designed for all conditions particularly where pavement repair costs are prohibitive. Such small opening repairs are scarcely noticeable when pavement is replaced.

Normac Clamps can be installed in large as well as small openings.

Norton - McMurray hold definite leadership in the development of methods for installation and rehabilitation work through small openings. We welcome the opportunity to help solve a problem you may have—tell us about it.

Write for our catalog describing our complete line of COUPLINGS . . . FITTINGS . . . SERVICE TEES and ELLS . . . SLEEVES . . . COMPRESSION-END COCKS . . . METER BARS and BRASS FITTINGS for copper pipe.

NORTON-McMURRAY MFG. CO.

39 SOUTH LA SALLE ST. • CHICAGO 3, ILL.

Method and product covered by U. S. Patents, Nos. 2,163,261 and 2,178,286.

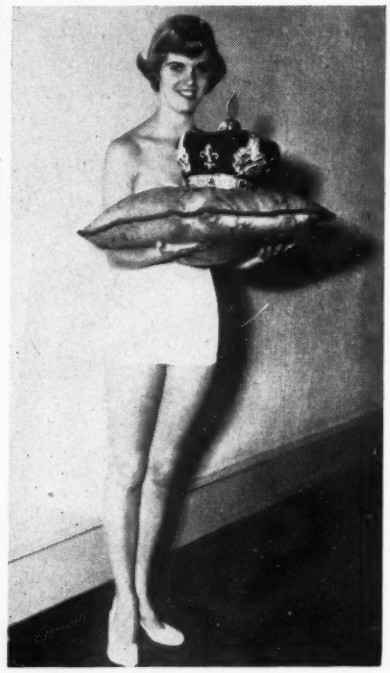
W. Va.; Sam Loper, Model Kitchen, Wichita, Kan.; M. M. Musikantow, Peoples Gas, Chicago; George Kilpatrick, Temple (Texas) Gas Equipment Co.; and L. K. Ward, Gas Appliance Center, Los Angeles.

First award of $200 for apartment house installation — nationwide — went to Robert Eldredge of Brooklyn Union. Peoples Gas, Chicago, led utilities in this category.

Hours Extended for GAMA Show

With a record 175 manufacturers enrolled as exhibitors for what promises to be the most outstanding GAMA show ever held, the association's assistant managing director, Harold Massey, has announced that visiting hours for the forthcoming exhibition of gas appliances and equipment in Atlantic City Oct. 2-6 will be extended. Booths will be open until 6 p.m. Monday through Thursday to permit anticipated capacity crowds to view a larger number of exhibits.

Oct. 5 has been designated "Dealer Day," with more than 2000 dealers expected to attend. The "King of the Court of Flame" will be crowned during the special dealer meeting, which will be a general session with a program planned particularly for the merchandisers.



This jeweled crown will adorn the head of the top gas water heater salesman in the U. S. following coronation ceremonies to be held Oct. 6 at the GAMA show in Atlantic City. The "King of the Court of Flame" will also receive a large share of $3000 worth of prizes—made of Fiberglas materials —to be awarded by Owens - Corning Fiberglas Corp. All expenses will be paid to and from the AGA convention, and a "boatload" of prizes worth $500 will be his. Each of the 49 "knights"—top salesmen in each state and Hawaii—will receive $50 worth of Fiberglas prizes in addition to regular awards.

Sales Slants

Brooklyn Union's 10-year plan to replace hundreds of obsolete and defective ranges in use in schools in Brooklyn and Queens was put into action in mid-July, when the first of 330 new gas ranges—to be installed in the next four months—left the utility's warehouse. Signal for the start of activity was the approval by the board of education of a $25,000 purchase order. The complete program, which includes other boroughs and utilities in New York, calls for a $51,719 outlay to replace 646 outmoded cookers.

A nationally-aired radio show, beamed from 910 stations to an estimated 22 million housewives, has been started by Empire Stove Co., Belleville, Ill., to plug its gas ranges. The campaign ties in with three popular network shows, and will continue throughout the fall season.

Portland (Ore.) Gas & Coke Co.'s outstanding advertising program has won recognition in many quarters. The Advertising Assn. of the West has selected its spot announcement as the best entry from over-100,000-population cities; the Public Utilities Advertising Assn. gave it two firsts and two thirds for excellence; and the car card featuring a glowing pile of briquets with the caption, "They Burn All Night," topped all competition in the Oregon Ad Club contest. The spot announcement's unique approach was a "five seconds of silence" pause, selling silent gas refrigeration.

Prize-winning CP demonstrations are now available for sales and home service departments, with the publication by AGA of a booklet containing the 29 prize-winning entries in the contest sponsored by the association last spring. The first four, "Adventures in Cooking," by Isabel A. McGovern, Minneapolis; "Twenty Minutes Before Dinner," by Margaret Bauer, Rochester; "Cooking That Clicks," by Lois Payne, Mt. Vernon, N. Y.; and "CP Cooking Perfection on a Gas Range," by Lucille E. Boettcher, St. Louis, are reproduced in full. Scripts only of the remaining 25 are included. Price, 25 cents each.

FINANCIAL

EXCESS PROFITS

AGA, EEI join forces to study tax question

The gas industry, anxious to avoid the unhappy consequences under which it had to operate following enactment of the excess profits tax during World War II, is taking measures to see if it can't get a little more favorable treatment should such a tax be enacted in the present emergency. The American Gas Assn. and the Edison Electric Institute have formed a joint committee of 10 to study the matter and to make recommendations.

Such a tax would strike at "unfair and unreasonable" profits during the national emer-

A TERRIFIC HIT!
BETTER MECHANICS PREFER
TOLEDO 1R
THREADER
FOR 1" to 2" PIPE
because
It's ACCURATE!
Perfect threads produced by separate Toledo Dies for each pipe size.
It's EASY THREADING!
Less friction due to famous Toledo receding die principle—small die segments with only a few cutting teeth backed by taper pins.
It's LOW COST!
Simple in design with one ratchet handle.

Do your next 1" to 2" pipe work with a Toledo 1R Threader—the tool that's "tops" with better mechanics! Similar to the famous No. 1 and No. 1A Toledos—but *simpler in design* with one ratchet handle and *low in cost!* A separate set of dies for each size of pipe—1", 1¼", 1½" and 2"—assures longer die life. Each set is hobbed for just the proper clearance. This means easier cutting, smoother, cleaner, more perfect threads and tighter pipe joints! Die change is quick and easy . . . or, many users prefer separate tool for each size. Durable . . . saves job-time . . . reduces costs! Ask your distributor for details and price . . . or send coupon.

RELY ON THE LEADER

TOLEDO

POWER PIPE MACHINES
POWER DRIVES
PIPE TOOLS

SEND COUPON

The Toledo Pipe Threading Machine Co.
Toledo, Ohio

Without obligation, send bulletin No. 650 and price on Toledo No. 1R Threaders, 1" to 2" pipe.

Name.....

Firm.....

Street.....

City.....State.....

gency. The gas industry feels that such ballooning profits are never possible for it, since gas rates are closely watched by state and federal regulatory agencies, and pegged at a "reasonable" level.

However, the stipulation that 50% of debt was the maximum amount to be included in invested capital, from which base the margin of profit would be figured, is a tough limit to put on utilities that have such a large percentage of debt to total investment. Gasmen feel that they should be allowed to include 100% of debt structure in invested capital.

The industry will not try to get special favors from congress, spokesmen said, but it is anxious that the special nature of government-regulated utility finances be considered.

Richmond Slashes Rates, But Upward Trend Continues

Four gas utility companies, one a municipally owned system, were engaged in changing their rate structures last month:

City of Richmond, Va., will have lower gas rates this fall. The city council voted 8 to 0 to adopt rates that would reflect the city's changeover to natural gas—rates that will save house-heat customers up to 20% and bring fuel economies to the city's industrial users.

Portland (Ore.) Gas & Coke Co. announced rate increases that will add $562,000 to its annual revenue. The increase amounted to 6.4 cents per Mcf; it was the first one to follow four rate decreases in 1949.

Lone Star Gas Co. hoped last month that its industrial increase—averaging from 5% to 7% per customer—would be big enough to forestall any future boosts. Domestic, commercial, and small business rates were not affected.

Coast Counties Gas & Electric Co., Santa Cruz, asked for its first rate increase in 30 years. Proposed general increase would bring the company an additional $1.3 million yearly. The company's application asks that new, higher rates be made effective Jan. 1.

Escalator Rate Clause Use Denied California Utilities

Petitions to raise industrial natural gas rates by Southern Counties Gas Co. (Los Angeles) and San Diego Gas & Electric Co. were suspended by the California Public Utilities Commission last month. The two companies, both of which have escalator rate clauses, pegged to the price of fuel oil, had asked increases of 2½ cents per Mcf after oil prices went up 15 cents per barrel.

The commission halted the rate increase in order to "prevent discrimination in the area." This meant that Southern California Gas Co. (Los Angeles) which operates in the locale also, and which has no such escalator clause, should be included in any granting of rate hikes, so that SoCounties and San Diego customers wouldn't pay more than their neighbors who are served by SoCal.

SoCal has a rate increase now pending before the commission.

Syracuse Refund Ordered

Refunds to customers that total about one-third of a million each year have been ordered by the New York Public Service Commission for gas consumers in the Syracuse-Oswego area. Niagara Mohawk Power Corp. must refund $365,000 for each year since Dec. 1, 1947, and must reduce its current rates by $282,000 annually.

Introduction of natural gas into the area, the commission said, brought about operating economies not reflected in the rates being charged by the corporation. The company was told to file new permanent tariff schedules to reflect the revenue reductions outlined by the commission.

32 Qualify for Report Awards

Ten manufactured gas companies and 22 natural gas companies have been qualified for the competition for *Financial World* magazine's Highest Merit Award for corporation annual reports.

The companies are now eligible for one of the magazine's Oscar of Industry awards, to be presented this year at a dinner to be held in New York Oct. 30.

Gas companies qualifying are: Brooklyn Union Gas Co., Equitable Gas Co., Hartford Gas Co., Laclede Gas Light Co., Peoples Gas Light & Coke, Portland Gas & Light Co., Providence Gas Co., Suburban Propane Gas

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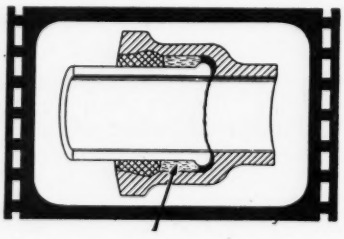

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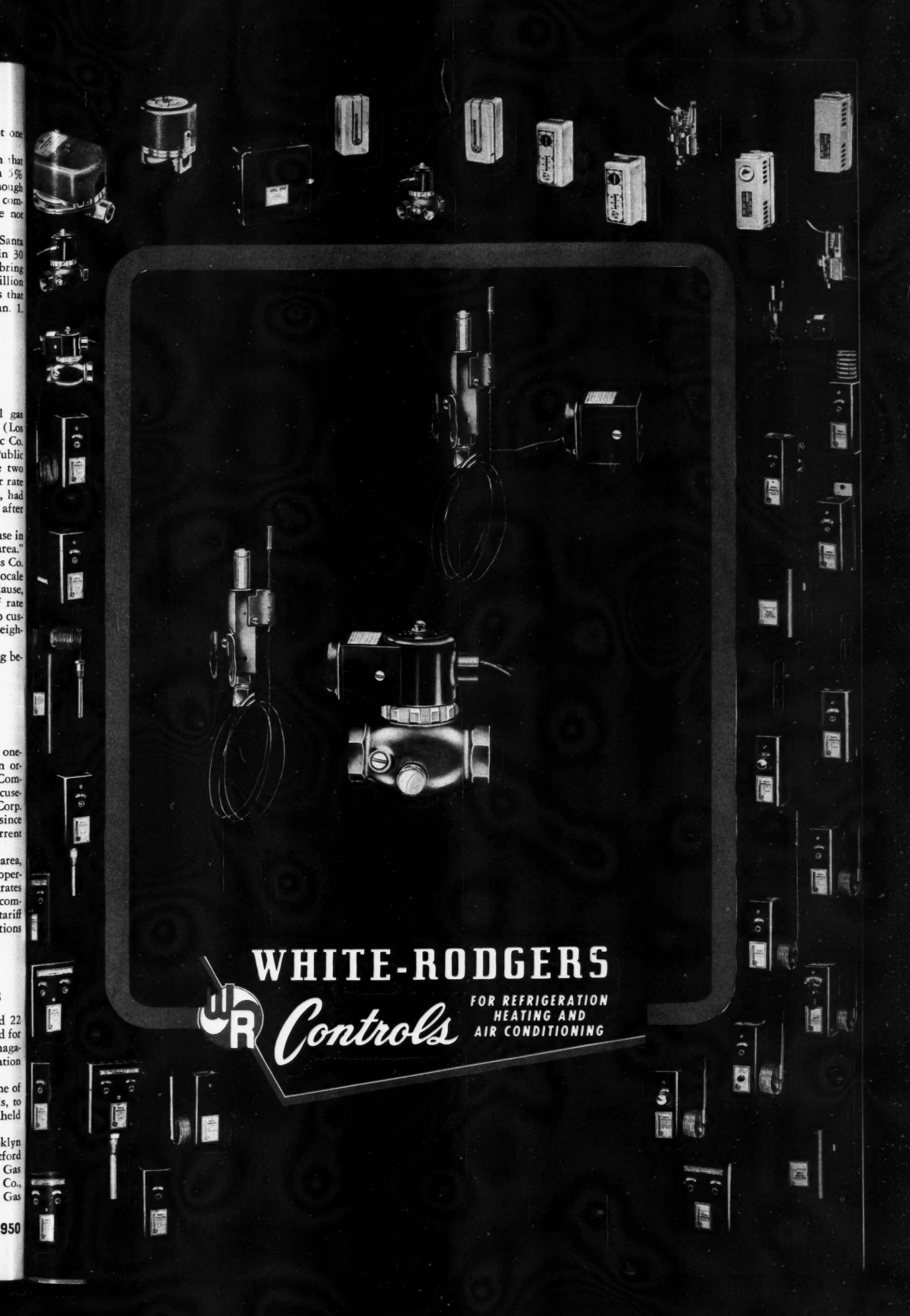
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June Sales up 18%

Total sales of gas by utilities to ultimate consumers for June 1950 went up 18.3% over those for the same month last year. Total sales were more than 2.9 billion therms for last June, an AGA report said.

For the year ended June 1950, gas sales totaled 38.9 billion therms, up 11.9% from the total for the previous year. For both periods, natural gas sales were on the increase (20.4% more for this June over last) and manufactured gas sales waned (decrease of 6.7% over June 1949). Sales of mixed gas were up 10.9% for June 1950 over the same period in 1949.

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MANUFACTURERS

Blaw-Knox Wins Contract for Storage Dehydration Plant

Contract for the construction of a natural gas dehydration plant to handle gas coming from New York State Natural Gas Corp.'s proposed underground storage project in Tioga county, Pa., has been awarded by the Pittsburgh company to the Chemical Plants Division of Blaw-Knox Co.

Costing $250,000, the plant, scheduled to go into operation in December, would process 200 MMcf per day initially, 300 ultimately with design changes. Operating at a pressure of 1000 psi, it would employ a solid desiccant; suitable automatic controls would give exact regulation of dew point.

Last month, FPC was pushing through New York State's application for the underground storage program in hopes of early approval.

Cast Iron Pipe Plant for West

The first plant to produce centrifugally cast iron pipe on the Pacific Coast is now under construction by United States Pipe & Foundry Co. on a 70-acre plant site recently purchased in Decoto, Calif.

Employing about 125 men, the $250,000 facility will produce pipe 4 to 12 in. in diameter. Designed by the company and being built by the Austin Co., it is scheduled for completion during the latter part of 1951.

This plant will be U. S. Pipe's fifth, the others being located in Burlington, N. J. (company headquarters); Bessemer and North Birmingham, Ala., and Chattanooga.

Stauffer Moves to New Home

Stauffer Manufacturing Co. has completed construction of its new manufacturing plant at 2453 Merced Ave., El Monte, Calif., according to announcement by G. W. Adams, president. The company is a supplier of pipeline plugs and couplings to the gas industry.

A 300% increase in demand for the company's plugs and couplings since 1946 necessitated the expansion of Stauffer's production facilities, Mr. Adams said. The company's former address was in South Gate, Calif.

The gas industry is now the major user of Stauffer's products, Mr. Adams reported, and he said that the new plant will up production speed and make quicker deliveries possible.

Columbia Leases Steel Foundry

Anticipating that the needs of national defense will require large amounts of steel entitled to priority in production, Columbia Steel Co., a subsidiary of U. S. Steel, has leased from the government the steelmaking facilities of the wartime steel foundry at Pittsburg, Calif., having a capacity of approximatly 60,000 tons of ingots yearly.

This foundry was constructed and operated during World War II by Columbia Steel Co. as lessee from the government and, except for a brief period, has been idle since that time.

MISCELLANY

TRUMAN RAPS CON ED

Gas to abate fume nuisance at UN denied

President Truman jabbed at Consolidated Edison Co. of New York last month, for what he termed "an attempt to rob the ordinary consumer of cheap fuel" in ConEd's request for more gas so that its waterside generating plant would no longer give off smoke and fumes that pollute the air around the new United Nations building.

Mayor William O'Dwyer of New York had written President Truman, requesting that an additional allocation of natural gas be given ConEd so that the plant could be converted, eliminating the nuisance. The president, upon recommendations of Mon C. Wallgren, FPC chairman, turned the request down cold. In his reply to President Truman, Mr. Wallgren said that to give ConEd more gas would necessitate another pipeline from the gulf area, since all of the gas carried by Transcontinental's big new line is already spoken for, and that "it would be a rather unique situation if . . . natural gas were allocated to an electric energy generating plant at the cost of sending natural gas to domestic, commercial, and superior industrial users . . . Consolidated Edison could abate its nuisance with the proper use of controls and regulating equipment."

UN Secretary General Trygve Lie had originally complained to the mayor that the smoke nuisance was "potentially dangerous." Construction workers had objected, he said, and permanent damage to the building materials as well as the danger of pollution of the building's air conditioning system was foreseen.

Conversion Booklet Scores Hit for Green Bay Utility

Almost any questions a gas consumer could pose about the difference between manufactured and natural gas were taken care of before he could ask them by Wisconsin Public Service Corp. this summer. The Green Bay company published a four-color, 24-page booklet for its customers, explaining almost all the whys and wherefores of conversion—and incidentally doing a bang-up promotional job simultaneously.

Questions answered in the booklet run the gamut from "Why will natural gas be better?" to "Will conversion be a nuisance?" and "What jobs will natural gas do better?" Each explanation has cartoon drawings in color to emphasize the answer.

The anticipation of the puzzlement that a big changeover operation can bring to gas users, and the publication that dispels that puzzlement, bore fruit for the company: because customers knew what was happening, conversion was made easier; gas appliance promotion material had almost 100% readership; and the company was freed from the task of answering dozens of individual queries about the "strange new fuel from Texas."

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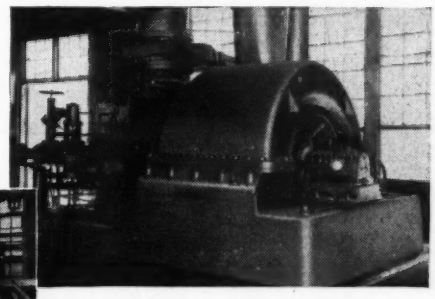

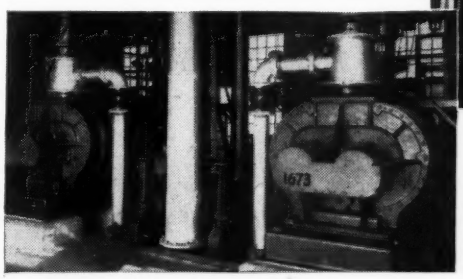

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Newsnotes

Chattanooga, Tenn., had a big ceremony Aug. 15 — complete with a mayors' egg-frying contest — to welcome the first natural gas to the city. More than 100 citizens turned out at the local high school staudium to watch the lighting of the blue flame at the end of the pipeline that brings Texas gas to Tennessee.

A gas househeating freeze was clamped on 258 communities served by Consumers Power Co., Jackson, Mich., last month. The ban was put on by the Michigan Public Service Commission after Consumers had said that its facilities to serve gas for househeating had been far outstripped by demand. Some new homes in specific areas, and a few small communities, were excluded from the ban. Among cities on which restrictions have been ordered are Flint, Lansing, Pontiac, Saginaw, Bay City, Jackson, Kalamazoo, Owosso, and Royal Oak.

Southwest Research Institute, San Antonio, has just completed construction of a new building (1820 sq ft) to house its physics department. The building, which was constructed using the new Youtz-Slick lift slab building method, was necessitated by an increasing volume of work in electronics by the institute.

A new safety kit, introduced with the council's calendar contest, has been announced by the National Safety Council, Chicago. The kit contains instructions for the organization of safety campaigns, contests, and programs, and is to be used in conjunction with the council's cash-prize limerick contest, held monthly.

CIO United Gas Coke and Chemical Workers, Local 18, Milwaukee, is taking a Wisconsin utility antistrike law to the U. S. Supreme Court for a constitutionality test. The union's battle to declare the law illegal has already failed tests in the Wisconsin supreme court and in a district federal court.

A new course entitled "petroleum refinery engineering" has been added to the graduate program of the School of Chemical Engineering at the University of Oklahoma. This course, to be offered in September 1950 for the first time, will consist of a series of lectures and problems related to the design of various pieces of refinery equipment, as well as the assembly of these elements into the complete design of a process.

Utility Readies Emergency Plan

At least one public utility has made rapid progress in organizing for the international emergency situation. The Philadelphia Electric Co. has announced formation of a company mobilization crew to guard against service difficulties in an emergency period.

Included in the plan is appointment of Ralph V. H. Wood, Philadelphia Electric engineer, as defense coordinator, and John A. Purcell, the company's western division manager, as deputy defense coordinator. The company will cooperate with city, state, and national security and defense agencies, under the pattern established in the company during World War II.

Pressure Fight in Syracuse

Syracuse (N.Y.) Suburban Gas Co.'s complaint against threatened pressure variations in gas delivered to it by Niagara Mohawk Power Corp. will be heard in an FPC session starting Sept. 5 in Washington.

Syracuse Suburban alleges that since 1913 it has been served by Niagara Mohawk at pressures ranging from 2 to 5 lbs in summer and 3 to 6 lb in winter, but that these will be reduced according to advice of Niagara upon completion of a new high-pressure line from Therm City to De Witt, N. Y.

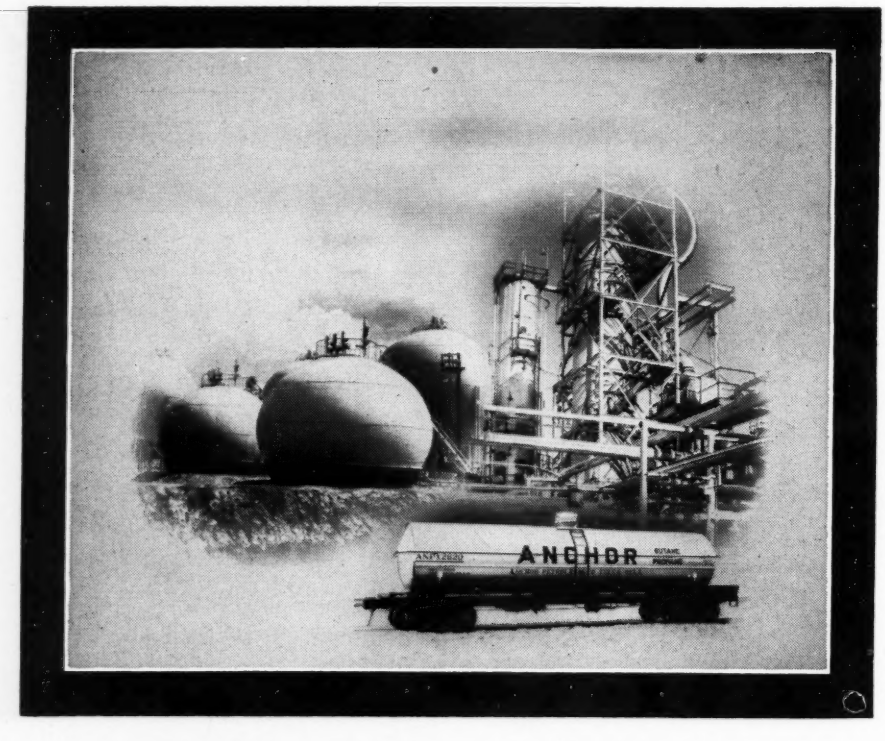
Niagara Mohawk, says Syracuse, will at that time not guarantee pressures exceeding 1 lb in summer and 2 lb in winter. This, says Syracuse, is tantamount to a rate increase, and will require installation of boosters in its system.

Technical School Session Begins

More than 50 students are expected to enroll in the courses in gas fuel technology starting Sept. 25 at Southern Technical Institute, Chamblee, Ga.

Fred A. Rives, chairman of the advisory committee named by the Liquefied Petroleum Gas Assn. to work with Southern Tech on the course, announced an anticipated increase in registration over last year.

The 18-month accelerated curriculum, which offers broad technical training to young gas industry men, is open to graduates of accredited high schools throughout the U. S. LP-Gas marketers, manufacturers, producers, and local associations have awarded scholarships in the past to members of their companies for study at Southern Tech.



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Planning a Corrosion Control Program: II

H. W. Hanes

In this second installment of the AGA corrosion symposium, H. W. Hanes and F. E. Kulman discuss the planning for operation and maintenance and the detailed organization of a corrosion department. Further steps in the program will be treated next month.

Plan for Adequate Operation, Maintenance

By HENRY W. HANES
United Gas Corp., Houston

NO corrosion engineer will recommend the use of cathodic protection unless plans are prepared to operate and maintain the cathodic protection installations adequately. The design of cathodic protection installations, if well engineered, takes into consideration the policy which the company will follow in operating and maintaining the installation. As an example, if very infrequent inspections and tests will be made, the use of galvanic anodes is preferred because they require less attention. Rectifiers should be inspected at least monthly to make sure that continuous protection is obtained. Also failure of rectifier which would connect pipeline to a graphite or carbon ground-bed could cause serious damage in a short time on a pipeline, especially on lines where corrosion pits were quite deep before the cathodic protection was installed.

Fortunately, operation and maintenance costs of cathodic protection systems are very low. One corrosion engineer with suitable equipment can operate and maintain many installations covering a considerable area. Most of the periodic testing usually can be done by a junior corrosion engineer, leaving the corrosion engineer free to design new installations to extend the use of cathodic protection on a system.

Adequate records of installations and performance of galvanic anodes, output of rectifiers, and the resulting protection to lines are essential. Records of all operating troubles encountered, such as rectifier failures, corrosion or failure of leads, and contacts with other lines are very useful as a guide in improving designs and for determining frequency of periodic tests necessary to insure maximum benefits from use of cathodic protection.

Periodic checks consist of measuring the current output of galvanic anodes, the output voltage and current of rectifiers, and the resulting potential-to-soil or potential to other reference, of the lines under protection.

Where tests show that troubles have developed, it then becomes necessary to determine the cause, which may be a contact which has developed between the protected line and some other line or structure; or a bushing may have been left out of a meter loop; or the resistance of an anode or ground bed increased considerably. It is a simple matter to conduct tests required to determine the source of trouble.

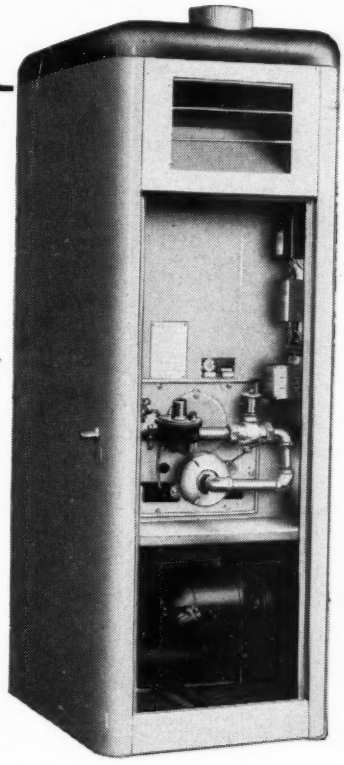
As previously mentioned, a frequent cause of trouble is an insulating bushing left out of meter loop by the meter installer or replacer. Another cause is from contacts due to other pipeline operators installing a new line or service without providing sufficient clearance at crossovers.

Organization of a Corrosion Department

By F. E. KULMAN
Consolidated Edison Co. of New York, Inc.

THE success of the corrosion program and the savings resulting from installation of cathodic protection and other corrective measures will be directly proportional to the knowledge, experience and ability of your corrosion engineer or your corrosion consultants.

LOW or HI-BOY...



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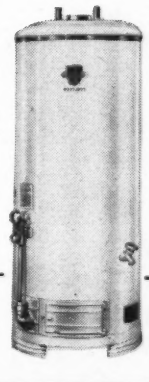

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To assure the success of corrosion programs, the corrosion engineer would have both technical qualifications and personality, to enable him to get along well with all departments and personnel from the ditch diggers and pipeliners up to chief executives. His decisions may be responsible for the expenditure of $50,000 to $100,000 annually. A few mistakes or poor judgment on his part can be very costly. Therefore choose the corrosion engineer as carfully as you choose any top-level engineers. Consider this—one can judge the soundness of engineering design and recommendations prepared by gas and mechanical engineers, because of broader and longer personal experience in that field. You may not be in a position to judge whether your corrosion engineer's designs and recommendations and his methods of attacking corrosion control are sound and practical, because of your lack of experience. Therefore, it is highly essential that he have broad experience on corrosion problems.

Corrosion Consultants

For a company having a corrosion problem on a specific line, use of a corrosion consultant probably would be most desirable and economical. But if cathodic protection is to be installed and maintained, the company preferably should have one of its own engineers work along with the corrosion consultant to learn as much as possible about the field testing and use of special instruments required, in order to be better equipped to maintain and operate the installations after their installation.

Many companies will desire to organize a corrosion section in their engineering department. The important question is how to select qualified personnel, consisting of a responsible corrosion engineer, possibly two field testers, and two junior testers. Descriptions of duties for each of these positions have been prepared in the form of job sheets (see below). With these job descriptions in hand, it should be possible for management to fill the positions with personnel from within or outside the organization.

Inasmuch as corrosion is fundamentally electrical in nature, it has been found that, in general, engineers with electrical engineering background and education are preferred by many companies for corrosion engineers. .Many gas companies may not have electrical engineers on thir staffs. It may be difficult to secure a corrosion engineer having the broad experience and other qualifications desired. There are at present no full-fledged corrosion courses being provided at colleges and most experienced corrosion engineers are now employed.

It may be desirable, therefore, to hire an electrical engineer, preferably one who has had a few years of engineering experience, and to provide the necessary "on-the-job" corosion training for him. There are some corrosion consultants who specialize in providing such "on-the-job" training by sending their engineers to the company's property to assist in organizing and planning a corrosion control program, as has previously been discussed, and at the same time training the company's personnel and corrosion engineers. This procedure has been followed by a number of companies and has been found to be very effective with outstanding results. Once a corrosion engineer has ben trained to head the corrosion department, he then can provide similar "on-the-job" training for junior corrosion engineers to assist him in the field work.

Don't expect a young inexperienced engineer to become an experienced corrosion engineer in a couple of weeks or even a few months. Many years may be required to develop the technical background and experience required to solve corrosion problems.

Position Description: Corrosion Engineer

1. *Duties of Corrosion Engineer*

To consult with transmission and distribution design engineers on methods of providing corrosion control on new installations of pipe, including selection of pipe materials and coatings, location and selection of galvanic anodes, rectifiers and ground beds, location of insulating joints. To check the design drawings for these features.

To make statistical studies of leak records, pipe life, soil tests, and electrolysis field data with a view to evaluating the severity of the corrosion problems and assist in setting up or revising company policy with respect to corrosion control measures.

To plan the annual testing schedule for check testing the coated pipes, anodes, insulating joints, rectifiers, and other measures installed for electrolysis control.

To represent the company on the local electrolysis committee and maintain liaison on electrolysis matters with other utilities in

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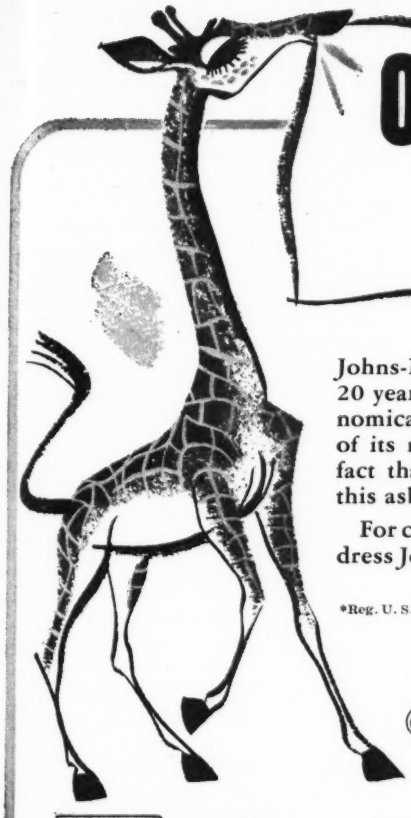

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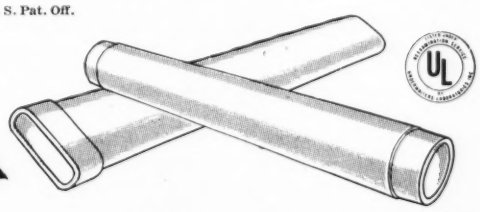

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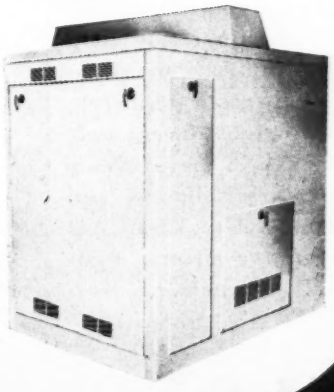

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the area. To attend technical conferences and participate in committee activities of AGA and NACE.

To interview representatives of manufacturers of materials for corrosion prevention, and advise purchasing agents on suitability of the materials offered.

To prepare engineering specifications, construction standards, and purchase specifications for corrosion preventive materials.

To provide "on-the-job" training for junior corrosion engineers.

To promote full cooperation of all departments in corrosion mitigation activities.

2. *Knowledge and Skills Required*

Detailed knowledge of existing company construction practices, testing, and operating methods.

Technical knowledge of advantages and limitations of various pipe metals, coating materials, metals for galvanic anodes, other materials, rectifiers, ground-bed characteristics, instruments.

Skill in making economic and statistical comparisons.

Ability to represent company position in conferences.

3. *Review of Decisions and Judgments*

Responsible for all decisions and judgments of technical nature on corrosion problems. These decisions and judgments are reviewed only for compliance with standing company policy. Decisions involving expenditures by the company or other utilities are approved by higher supervision.

4. *Help Provided by Supervisor*

The supervisor may not be in a position to judge whether the corrosion engineer's designs and recommendations are sound and practical. Hence no assistance can be obtained from the supervisor except on matters of policy.

5. *Importance of Work Done*

The effect of the work done will be manifested in the long run in reduced frequency of corrosion, longer service life of underground piping and most economical operation costs.

6. *Personal Work Contacts*

Consultations are held with corrosion engineers of other utilities on joint corrosion problems, with a view to arriving at mutually satisfactory solutions.

7. *Qualifications*

A degree in electrical engineering or equivalent in education and experience. Preferably a license to practice professional engineering.

Five years of experience concerned with corrosion surveys or protective measures. Some experience in construction, operation, or design of piping systems would be desirable.

Experience in, or familiarity with, methods of comparing costs, analyzing statistical results, and presenting conclusions and recommendations.

Position Description: Corrosion Tester

1. *Duties of Corrosion Tester*

To plan and execute details of daily testing program in accordance with general instructions received from engineer. This includes supervising the work of one or two assistants, reading instruments and recording results of tests using voltmeters and ammeters of indicating and recording type, soil resistance rods, pH, and other instruments. To be responsible for accuracy of recorded test data. The tests include pipe-to-soil potentials using copper sulfate cells, pipe current, soil pH, soil resistivity, soil aeration, high-voltage tests on coatings, insulation resistance and over-the-ground tests on installed coated pipes, tests on installed rectifiers, anode beds, and galvanic anodes.

To interpret test results and prepare and present oral and written reports including tabulations of data and sketches and discussion of results and to assist engineer in preparing conclusions and recommendations.

To be responsible for care and proper use of electrical instruments and testing equipment.

To train assistants in proper procedures for corrosion testing.

2. *Knowledge and Skills Required*

Knowledge of fundamentals of electrochemical reactions, Ohm's law, Faraday's law, electrical measurements, and testing instruments.

Knowledge of locations of gas manufacturing plants and holder stations and connecting gas mains.

Locations of railway substations and their operating schedules.

Skill in analyzing and interpreting results of measurements.

Skill in preparing and presenting reports.

3. *Nature of Instructions Received*

Before the field testing is begun, the engineer discusses the objective, scope and nature of the tests, suggests available instruments which may be used and possible methods of approach. A tentative plan of testing is agreed on, which must be followed in principle. If major changes in the plan are required, as the result of the progress of the tests, these changes will be discussed with engineer before being put into effect.

4. *Review of Work*

The tester will give frequent verbal reports of the tests results to the engineer and present written reports as occasion warrants. The engineer will assist in forming the conclusions and will be responsible for the soundness of the recommendations.

5. *Guide Lines*

Since most of the testing work is investigational in nature, and its direction is based on current testing results, the effectiveness of the corrosion program is dependent greatly on the good judgment and experience of the tester in guiding the tests. This experience is developed by actual practice or in a training program which may be sponsored by a large public utility or by a consulting firm experienced in corrosion testing.

6. *Qualifications*

Training equivalent to completion of two full years of engineering college with courses in electrical measurements and electrical machinery. Personal qualities of resourcefulness, adaptability of new methods, and ability to make decisions in field and supervise work of others.

With the thought that the corrosion testers will be developed into corrosion engi-

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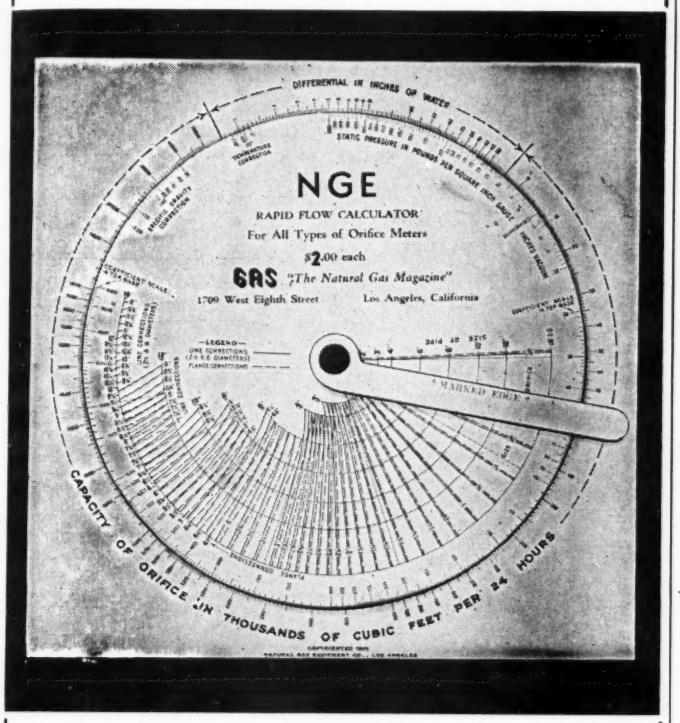
CALCULATOR

FROM 2 inches TO 16 inches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RAPID FLOW CALCULATOR
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CAPACITY OF ORIFICE IN THOUSANDS OF CUBIC FEET PER 24 HOURS

. . . will quickly compute any of a series of variables in the transmission of natural gases.

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50 GPH to 10,000 GPH

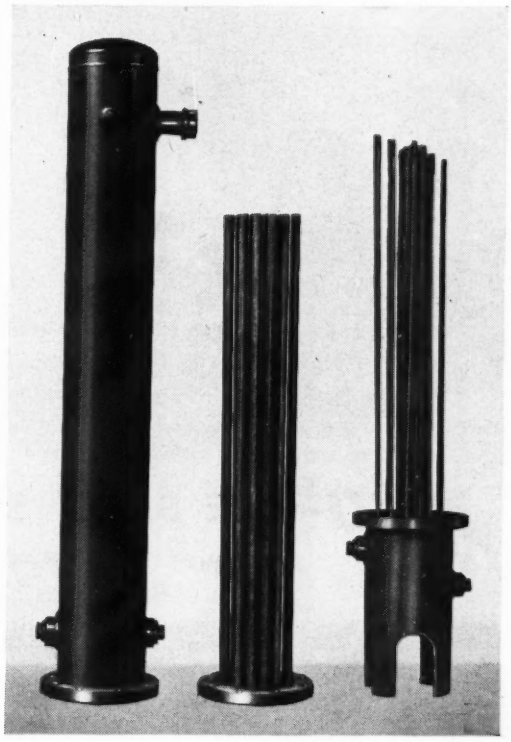

Photo above shows Armstrong Size "D" propane vaporizer dis-assembled, illustrating easy access for repair, cleaning or inspection with minimum effort.

Standardized Vertical Vaporizers available in sizes from 50 gph. to 2000 gph. vaporized per hour, propane or butane. Heating medium steam or hot water. Highly improved mechanical design.

Horizontal Reboiler Type Vaporizers available in sizes from 2000 gph. vaporized per hour, up to 10,000 gph. in propane or butane. All steel units, with removable U-tube bundles.

All Armstrong Vaporizers carry ASME Stamp, Par. U-69

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Iron Sponge offers extremely high activity with maximum absorption. Periods between regeneration are longer while the regeneration itself is accomplished quickly and simply.

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STAUFFER PIPE REPAIR CLAMPS

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STAUFFER MFG. CO. El Monte, Calif.

neers, it probably would be desirable to hire electrical engineering graduates.

Position Description: Junior Tester

1. *Duties of Junior Tester*

Under immediate supervision of the corrosion tester to set up instruments, make electrical test connections to underground structures, read the instruments, and record the data.

To take care of electrical instruments and testing equipment.

To perform other related duties as directed by corrosion tester.

2. *Knowledge and Skills Required*

Knowledge of use of voltmeters, ammeters, shunts, and other electrical equipment.

Skill in reading the instruments accurately and recording results on data forms.

3. *Review of Work*

All work is reviewed by corrosion tester for conformance to instructions, and accuracy of readings.

4. *Qualifications*

Training equivalent to graduation from high school.

Interest in electrical testing.

Ability to follow instructions.

(To be continued.)

CURRENT READING

SOIL - CORROSION STUDIES, 1946 and 1948: Copper Alloys, Lead, and Zinc—by Irving A. Denison and Melvin Romanoff. Published as research paper No. RP2077 by the National Bureau of Standards. Copies are available from the Supt. of Documents, U. S. Government Printing Office, Washington, D.C., at 20 cents each.

This report contains the results of measurements of the corrosion of copper, lead and zinc, and certain alloys of these metals after exposure to different soil conditions for a maximum of 14 years. The soils to which the materials were exposed range from well-aerated soils deficient in soluble salts to very poorly aerated soils containing high concentrations of water-soluble materials. The magnitude and progress of corrosion with respect to weight loss and pitting are interpreted in relation to the composition of the materials and the properties of the soils at the test sites. Comparative data are given for the corrosion of plain iron and steel, copper, lead, and zinc in typical soil environments.

With respect to weight loss, tough pitch copper was generally more resistant than deoxidized copper and the copper-silicon alloys, except in soils high in sulfides. However, in a number of the soils, the maximum depths of pits on tough-pitch copper were greater than those on one or more of these materials.

The loss in weight of the copper-zinc and copper-nickel-zinc alloys was approximately in the order of increasing zinc content, except in soils high in sulfides in which the reverse order was followed. Admiralty metal (70% of Cu, 29% of Zn, 1% of Sn) showed the greatest tendency toward localized corrosion of any of the copper-zinc alloys. Although a two-phase leaded silicon brass (67% of Cu, 31% of Zn, 1% of Si, and 0.8% of Pb) showed the least tendency to developed deep pits, this alloy was dezincified in many of the

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- **Hi-Lo Valve Knobs,** perfect control with all types of gas.
- **Fluorescent Range Lamp,** built in, not just hung on.
- *Other Features Include:* plenty of storage space, convenient appliance receptacle, concealed vents and drip trays, close-spaced non-tilt oven racks adjustable to five levels, choice of grouped or divided surface burners!

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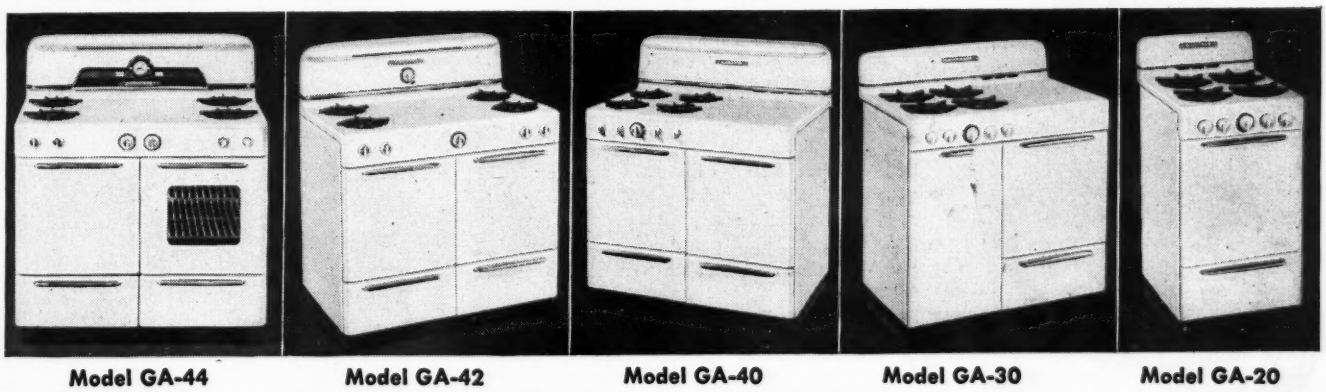

Model GA-44 Model GA-42 Model GA-40 Model GA-30 Model GA-20

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ACT NOW! Be sure *you* receive full information about this exciting new line. Murray has made high quality, low cost ranges for more than a decade. These all-new Murray Gas Ranges are the latest of over a million home appliances . . . now made in one of the world's largest and most modern plants.

YOUR CUSTOMERS will marvel at their new beauty, new performance, new ease of cleaning, new conveniences!

FOR DETAILS: If you are a wholesaler, kindly write on your letterhead; if an appliance dealer, kindly forward coupon.

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Forward full particulars about the Murray Gas Range Line.

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soils. All two-phase copper-zinc alloys were dezincified to some extent in most of the soils, except a 60-40 brass containing 0.08% of arsenic, which showed only superficial discoloration. The presence of arsenic did, however, induce intergranular corrosion in the specimens exposed to cinders.

No differences were observed in the corrosion of chemical lead, antimonial lead, and tellurium lead.

A die-casting zinc alloy had greater maximum pit depths than rolled zinc, but there was no significant difference in weight loss.

In general, copper, zinc, and lead, and alloys of these metals were corroded most severely in poorly aerated soils, particularly in soils that were highly acid or that contained high concentrations of soluble salts. Copper was corroded in soils high in sulfides. Lead was passivated by soils containing high concentrations of sulfates and chlorides.

AMERICA UNDER SOCIALISM — Published by The National Research Bureau Inc., 415 N. Dearborn St., Chicago 10, Ill. Designed for distribution to employees and members of civic groups, this 16-page, four-color, comic strip-type booklet tells the story of what happens when an American becomes blinded by bright promises of so-called security. As the story unfolds, the social state gradually controls more and more of his life.

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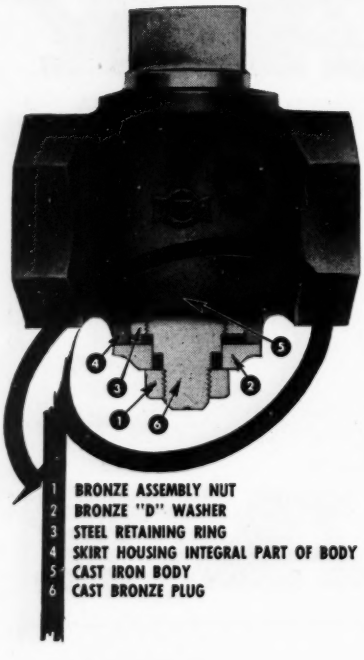
FEATURES


1 BRONZE ASSEMBLY NUT
2 BRONZE "D" WASHER
3 STEEL RETAINING RING
4 SKIRT HOUSING INTEGRAL PART OF BODY
5 CAST IRON BODY
6 CAST BRONZE PLUG

- Tamper-Proof Design with Non-Removable Plug.
- Extra Grade Gray Iron Body, Gas Service Bronze Plug.
- Steel Retaining Ring Prevents Removal of Plug.
- Steel Retaining Ring Assembled to Bottom of Plug—Eliminates Possible Damage to Precision Ground Surface of Plug and Body.
- Steel Retaining Ring Threaded and Staked to the Largest Metal Diameter on Bottom of Tapered Plug—Assures Retention without Distortion.
- Steel Retaining Ring Anchored without Drill Hole or Pin—Eliminates Possible Shearing of Plug.
- Steel Retaining Ring Located below Shoulder of Body—Permits Freedom for Service Adjustment of Plug.
- Steel Retaining Ring Recessed and Inaccessible within Iron Body—Gripless and Shearless.
- Plug and Body Precision Ground and Matched for Perfect Seating.
- Individually Tested Under Rigidly Controlled Inspection.
- Lubricated with a Compound of Greases Suitable for Use with Manufactured, Natural or Liquid Petroleum Gases.
- Obtainable in a Variety of Patterns.

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Black or Galvanized

Flat Head Less Check
Flat Head With Check
Flat Head With Lock-Wing

Sizes; ¾"—1"—1¼"—1½"—2"

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PEOPLE

F. B. Jones
... Equitable

Guy Ashworth
... Hays Mfg.

F. B. JONES has been appointed manager of Equitable Gas Co.'s new economic and management research department. Mr. Jones, who has been with the Pittsburgh firm since 1925, was manager of sales and market research. The company also announced the appointment of WILLIAM E. NARY, editor of *Public Service,* employee magazine, as director of publicity.

GUY T. ASHWORTH has been appointed sales representative in Louisiana, Mississippi, and Tennessee for Hays Manufacturing Co., Erie, Pa. Mr. Ashworth is an electrical engineer and has done post-graduate work while instructing at Louisiana State university.

NORMAN R. SUTHERLAND, vice president and assistant general manager of Pacific Gas & Electric Co., San Francisco, on Aug. 1 succeeded W. G. B. EULER as vice president and general manager. Mr. Euler is now executive vice president of the company.

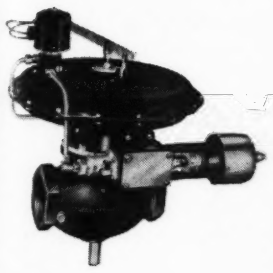
H. Y. SHIREY has been added to Perfection Stove Co.'s Oakland, Calif., district. He will travel the northwestern section of the country and will maintain headquarters in Portland, Ore.

A. D. Schrodt
... Southern Union

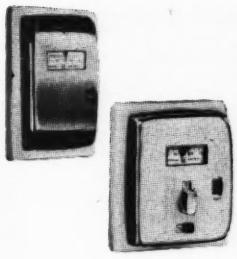
L. R. Sagar
... Dearborn

ALLEN D. SCHRODT has been named sales coordinator in charge of the merchandise sales division, a new department of Southern Union Gas Co., Dallas. Merchandise sales formerly were handled by the company's purchasing department, in which Mr. Schrodt served as assistant purchasing agent for two years. Since July 1948, he has headed the land and lease department.

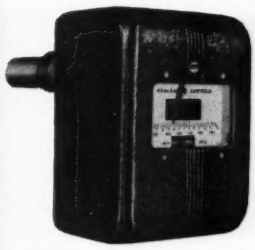
LESTER R. SAGAR recently was appointed process manager of Dearborn Chemical Co., Chicago. He will supervise production planning and the development of process equipment.



B-55 G Governor Type Valve



T-70 and T-70T Thermostats



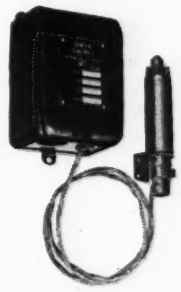
L-32 Immersion Thermostat

5B Interval, On-Off Time Switch

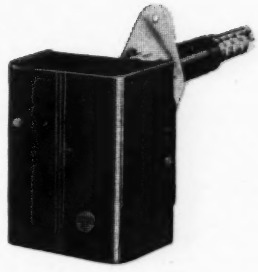
for better HEAT CONTROL check GENERAL CONTROLS

Whatever the *control* problem . . . whether it's *product* control . . . or *process* control . . . in any application where a higher level of operating performance is the goal . . . *automatic* controls more often than not form the solution . . . and in the field of automatic controls . . . there's certain to be a General Control that can be relied upon to do a better job. That's why more and more of the leaders in American Industry are joining in the big swing to General Controls . . . that's why there are so many new voices in the rising chant that,

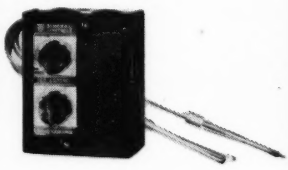
"for the best in automatic control, it's General Controls."



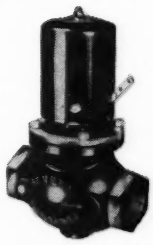
A-100 Thermopilot Relay



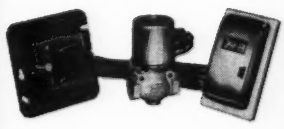
R-99 Stack Switch



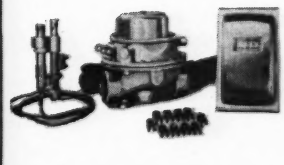
L-54 Solid Charge Combination Fan and Limit Control



Hydramotor G 1-7



T-30 Package Set



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Manufacturers of Automatic Pressure, Temperature, Level and Flow Controls

FACTORY BRANCHES: Baltimore 5, Birmingham 3, Boston 16, Buffalo 3, Chicago 5, Cincinnati 2, Cleveland 15, Dallas 1, Denver 4, Detroit 21, Glendale 1, Houston 6, Kansas City 2, Minneapolis 2, Newark 6, New York 17, Philadelphia 23, Pittsburgh 22, St. Louis 12, San Francisco 7, Seattle 1, Tulsa 6. DISTRIBUTORS IN PRINCIPAL CITIES

STAMANCO EXPERT HOLDER INSPECTION

-Saves You Money!

Even though your gas holders have had regular attention from your company maintenance crew - it will pay you to have an occasional inspection by STAMANCO Inspection Specialists who are --

EXPERTS in the prevention of trouble development

EXPERTS in the detection of present troubles

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STAMANCO Inspection Service can save you money by extending the life of your present holders....by reducing the possibility of shut-downs due to corrosion and mechanical troubles....by correcting factors which would eventually cause expensive major repairs. We shall be pleased to talk your holder maintenance problems over with you.

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LEAK LOCATION SURVEYS

SPOT & CHART YOUR *"leaking"* GAS SO DON'T DELAY

SAVE SAVE SAVE

that leaking gas by acting TODAY!

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PHONE WELLESLEY 5-3262

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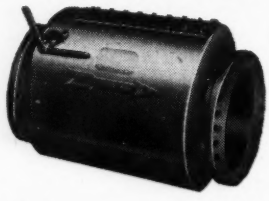

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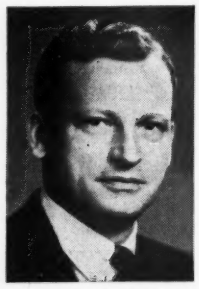
Flanged and Fabricated in Steel

For *GAS* and *AIR*— *LOW* and *HIGH PRESSURES*

Can be supplied for use with any pressures. Easily lubricated through grease fitting. Indicator shows position of disc. Can be counter balanced for vertical jobs. Dash pot can be installed to prevent chattering when passing high velocity gas or air.

NORWALK VALVE CO.
South Norwalk, Conn.

ROBERT A. HORNBY has been elected executive vice president of Pacific Lighting Corp., San Francisco. He was named vice president and executive engineer of the company in 1935 and has since served in that capacity. He succeeds LeRoy M. Edwards, vice president and director, who retired Aug. 1. Mr. Hornby's gas industry career includes six years in engineering, rate, appraisal, and accounting work for utilities and the California Public Service Commission, and a number of years with Southern California Gas Co., Los Angeles, as valuation engineer and controller.



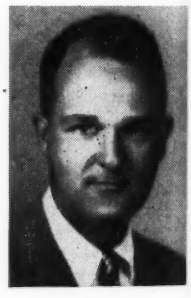
R. A. Hornby

FRANKLYN HEYDECKE, comptroller of Public Service Electric & Gas Co., Newark, since 1948, and general auditor for many years before, retired July 16 after 50 years with the company and its predecessors. F. WARREN COOPER has been appointed comptroller and FRANK FREER JR. succeeds Mr. Cooper as assistant comptroller.

WILLIAM C. STRINGFELLOW is one of four sales engineers recently appointed by General Controls, Glendale, Calif. He has been assigned to the Dallas branch office. Others are HAMILTON G. SUDLER to New York, ERNEST F. BRUEGEL to Philadelphia, and R. ROEDDER to Los Angeles.

ALEXANDER B. CLOUD has been named district sales manager of the New York territory, American Meter Co., New York. From 1936 until 1942 Mr. Cloud was located at the company's Metric Metal Works, Erie, Pa. He served in the navy until 1946 when he rejoined the firm as an assistant to the late John Van Norden. New district sales manager in Philadelphia is JOHN GRIBBEL II. After being graduated from Yale, Mr. Gribbel was employed by Philadelphia Electric Co. until he went into the navy, and he joined American Meter in 1947 as a sales engineer in Philadelphia.

A. B. Cloud



J. Gribbel II

JAMES M. WILCE has been named Janitrol sales engineer in the Lansing, Mich., area by H. C. Gurney, sales manager of the Janitrol domestic-commercial division, Surface Combustion Corp., Toledo. Mr. Wilce has spent a year at the Toledo and Columbus plants of Surface Combustion.

G. G. OBERFELL, vice president of research and development, Phillips Petroleum Co., Bartlesville, Okla., retired Aug. 1 after more than 25 years of service with the company. He was also a member of the board of directors and the executive committee. Changes resulting from Mr. Oberfell's retirement include the election of R. W. THOMAS, manager, research and development, as vice president of research and development; B. F. STRADLEY, secretary-treasurer, as a member of the board and the executive committee; and PAUL J. PARKER, assistant secretary and assistant treasurer, as secretary and assistant treasurer.

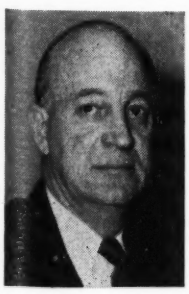
G. G. Oberfell

S. R. MATHISON has been appointed New England regional sales manager and JOSEPH M. MALONEY has been named New England district sales manager by the Home Appliance Division, The Murray Corp. of America, Scranton, Pa. Another recently appointed regional manager of the division is DONALD R. STONE, who will headquarter in Pittsburgh. RICHARD D. BOND has been named merchandise manager and ALBERT FELDER, associate merchandise manager. The new sales analyst for the division is JAMES D. HAZZARD. All three will be located in Scranton. Two appliance distributors also have been named—General Wesco Distributing Co., Springfield, Mo., and Thomson-Diggs Co., Sacramento, Calif.

S. R. Mathison

J. M. Maloney

WILLARD G. WIEGEL, director of personnel for Lone Star Gas Co., Dallas, took over Aug. 1 as treasurer of the company. He succeeded H. G. CORNATZAR who retired under the company's pension-insurance plan after more than 33 years of service. Mr. Wiegel, who was appointed advertising manager in 1930 and personnel director in 1942, will retain his position in the personnel department. Mr. Cornatzar joined Lone Star in 1917 as a bookkeeper and became the company's first traveling auditor. He was named treasurer in 1942.



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CHARLES F. WOODS was named valve division sales manager for Minneapolis-Honeywell Regulator Co.'s southwest region, headquartering in Dallas, in July. At the same time, a number of promotions and additions were announced by the company. EDWARD J. BYRNE, Houston branch, succeeded Mr. Woods as industrial manager at Dallas. HOWARD W. GRIESBACH, Chicago branch, was appointed Milwaukee industrial manager. Additions to the field sales staff included LOUIS C. SCHULTZ to Chicago and W. E. VAN HORNE to Rochester, for industrial sales; WILLIAM J. KIRBY to Los Angeles and P. R. VOGEL to Houston, for industrial supplies sales.

IRVIN H. JONES, manager of the patent section, research department, Koppers Co. Inc., Pittsburgh, on Aug. 1 became international development manager for the company. DR. W. J. MONACELLI, assistant manager of the patent section, has been named acting manager. RAYMOND H. HARTIGAN has been named manager of the laboratory section, central research department. Other appointments recently announced were those of GORDON BLACK as assistant manager of the development section and of PETER W. SHERWOOD as manager of the engineering branch of that section.

ROBERT F. ORTH, manager of Johns-Manville Corp.'s Transite asbestos-cement pipe department, was recently elected 1951 president of the Water & Sewage Works Manufacturers' Assn. The organization was established in 1908 for the advancement of business standards and practices between water and sewage works manufacturers and operators.

ORLO E. BROWN JR., research metallurgist, has been added to the staff of Robertshaw-Fulton Controls Co.'s west coast research and development laboratory in Los Angeles. Mr. Brown formerly served as metallurgist with A. O. Smith Corp.

G. W. HART has been appointed manager of advertising, sales promotion, and sales training of General Electric Co.'s air conditioning department. He succeeds E. S. McKAY, who has joined the company's public relations staff.

ARTHUR B. TESMEN has been appointed sales engineer by Tempil Corp., New York City. He will assist customers and distributors who encounter problems in temperature determination and temperature control.

E. W. Rubin

K. C. Lever

ERNEST W. RUBIN and KENNETH C. LEVER have been appointed branch managers by Empire Stove Co., Belleville, Ill. Mr. Rubin, who has been associated with Anco Manufacturing & Supply Co., has charge of the Tulsa branch. Mr. Lever's territory includes Kansas and northern Missouri, and he will have offices at Independence, Mo.

- OBITUARIES -

BERNARD M. LAULHERE, 64, former manager of engineering services for Southern California Gas Co., Los Angeles, died on Aug. 5 following a prolonged illness. Mr. Laulhere, who was employed by the Midway Gas Co. in 1921, later joined SoCal as supervising engineer. In 1946 and 1947 he was assigned to construction of the Texas-California transmission line. Shortly after completion of the line, he became ill. In 1939, Mr. Laulhere was awarded the PCGA's gold medal for co-authorship of a paper entitled "Partial Dehydration of High Pressure Natural Gas."

B. M. Laulhere

WILLIAM McKEEVER, 77, a construction engineer for United Gas Improvement Co., Philadelphia, died recently. Mr. McKeever contributed to the construction and development of gas plants in this country and South America.

LOUIS T. SHORLEY, 60, president and treasurer of Freyn Engineering Co., Chicago, a subsidiary of Koppers Co. Inc., died recently. Mr. Shorley, who had been associated with Freyn since 1917, had been president since 1946.

RAYMOND H. ULRICH, 51, vice president and general manager of Southern Natural Gas Co., Birmingham, was killed recently in an automobile-truck collision near Tuscaloosa, Ala.

ANSON C. BURWELL, 60-year-old vice president in charge of production and geology for United Natural Gas Co., Oil City, Pa., and affiliated concerns, died recently. He had joined the company in 1916.

GEORGE OLNEY, 75, a former vice president and general solicitor of the United Gas & Electric Co., New York, died late in July.

How El Paso Lowers-In Pipe When Using Slack Loops

By T. B. LaROCK

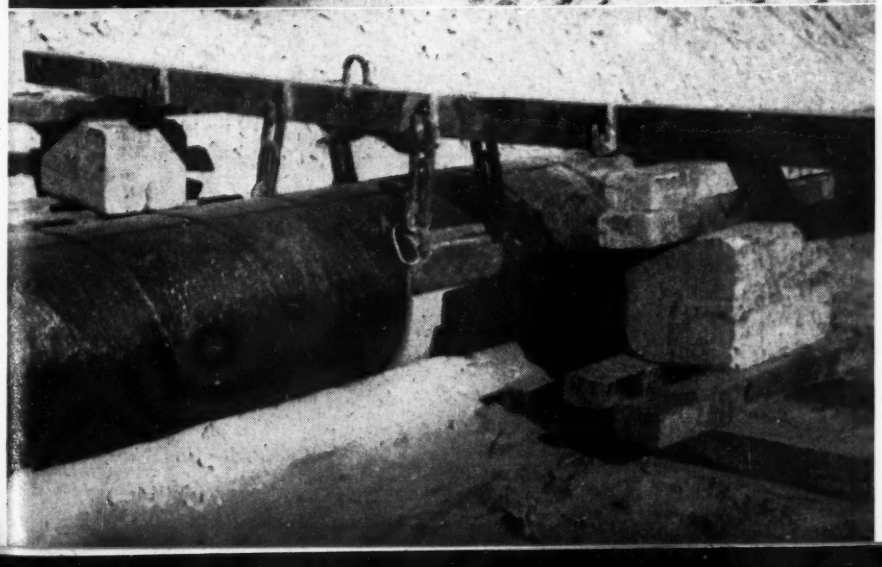
El Paso Natural Gas Co.'s 30-in. transmission line now under construction is essentialy a loop of the 26-in. line built in 1947 from the Jal-Eunice area of New Mexico, connecting the oil and gas fields of the Permian Basin with the distribution systems serving southern California at Blythe, Calif.—plus a cross-over line that connects this system to the line that will serve the San Francisco area at Topock, Ariz.

The seven booster stations on the 26-30-in. system are located at approximately 100-mile intervals. These operate at a maximum design discharge pressure of 840 psi and suction pressures to about 620 psi at some stations, depending upon load requirements.

The discharge temperature at all booster stations is maintained below 90° F. The suction temperatures have been recorded as low as 40°F during the winter in the predominantly colder eastern region of the line, while 45°F is the minimum suction temperature at the more westerly stations. The minimum recorded at the Blythe metering station has been 54°F. The maximum suction temperatures recorded are: 77°F at the eastern stations, 87°F at the booster stations on the western end of the line, and 93°F at the Blythe station.

The pipe used on the discharge side of all booster stations is of .335-in. wall thickness for approximately 50 miles. The remaining 50 miles of pipe is of .324-in. wall thickness to the suction of the next station. Main line block valves are located at approximately 8-mile intervals.

Two views of a slack loop suspended above the ditch. Two steel box beams, with belt slings to carry the pipe, are placed about 60 ft apart at the center of the loop, cribbed sufficiently high to hold the bottom of the pipe about 5 ft above the ditch bottom at the center of the loop.



EL Paso Natural has been accused of being "slack-happy." This we do not deny. We feel we have very good reasons for trying to put all the slack necessary in a pipeline. We operate in a section of the country in which seasonal atmospheric temperature variations range up to 100°F and the ground temperatures at pipe level range 40°F, as is illustrated by the station suction temperatures noted in the introduction.

Our original 16-in. line from Jal to El Paso was one of the first all-welded large-diameter pipelines built. This type of construction being new, the engineers recognized the need for some provision that would allow for contraction and expansion in the line owing to temperature changes. Expansion joints of the "wrinkle belly" type were used. These proved ineffective, as during the first winter of operation about 150 girth welds failed and during the second winter about 100 breaks occurred. Tests that were made on the expansion joints showed the tensile stresses did not cause movement of the expansion joints but were concentrated between the joints.

Granted that welding in 1928 and 1929 did not approach present-day

Mr. LaRock, of the engineering department, El Paso Natural Gas Co., presented this paper at the May 25 transmission conference of the Pacific Coast Gas Assn. at Santa Maria, Calif.

standards, partially offsetting this is the fact that pipe during that period was not stressed as is the pipe in today's transmission lines.

Girth Weld Failures

El Paso has had two other experiences where breaks in the girth welds have caused trouble. One occurred in a section of 16-in. line that was reconditioned during the summer of 1948. At that time the crew failed to provide adequate slack, with resulting girth weld failures the following winter. In order to correct this, the line was cut every 1000 ft and allowed to contract, after which "pup-joints" were welded into the line. No further trouble was experienced with this line. The other experience that we had with repeated failures of girth welds was in a section of 12-in. line that was welded with a new process, and probably all the slack in the world would not have helped the girth welds.

Since 1935, El Paso, which does its own construction, has built over 3000 miles of transmission lines. Since the beginning of the California project in 1947 we have built some 1600 miles of 20-, 24-, 26-, and 30-in. line, and have not had a single girth weld failure. We have had about 30 to 40 leaks due to pinholes or cracked welds. The cracked welds occurred in pipe whose carbon content was from 33 to 38 points, with manganese varying from 140 to 165 points. These cracked welds were located during the testing of the line before it was put into operation.

We believe we have top pipeline welders and that our welds are as good as those in any line. The welds are checked periodically by both gamma ray and destructive tests. But we also believe that, because of conditions beyond our control and at times beyond the control of the welders, every weld in our line is not 100%.

These thoughts have been advanced to show you reasons why we are "slack-happy."

Procedures

The ditch for laying the pipe is dug to a width of 44 in. and to a depth of 60 in. to insure a minimum of 30 in. of cover. This cover is increased to 60 in. where the line passes through cultivated areas.

The majority of the 30-in. OD pipe is strung on the line in 60-ft lengths after having been joined by automatic welding from two 30-ft units. The pipe is then bent to conform to the contour of the ditch. Wrinkle bends are predominant, with some portions of the line having been bent with the smooth type bending machine.

The pipe sections are then welded and coated with a coal tar enamel covered with either asbestos felt or a glass fiber-wrapping.

Lowering-in is delayed until the morning after the pipe has been coated to allow the coating to set and the pipe to cool.

During the hot spring and summer months the lowering-in procedure is begun as early as 3 a.m. so that the pipe will be in the ditch and covered before the sun can raise the pipe temperature.

Spacing of Loops

A break is left in the welded line every 3000 to 4000 ft to facilitate the handling of the pipe and to establish a new origin for measurement of the bends so as to minimize cumulative errors.

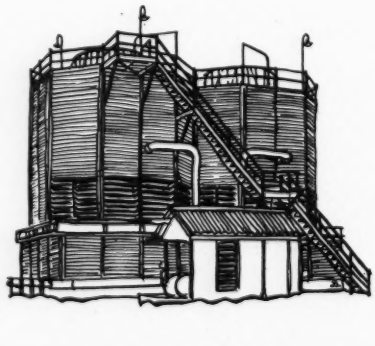
As the pipeline sections are lowered into the ditch, a 'dozer follows up, covering the pipe with the exception of the breaks and the slack loops. The breaks are left uncovered for a distance of 200 ft on each side of the loose ends.

The slack loops that are placed every 1000 ft between breaks consist of 400 ft of uncovered line suspended above the ditch. This is done by the use of two steel box beams with belt slings that carry the pipe. The beams are placed about 60 ft apart at the center of the slack loop, cribbed high enough so that the bottom of the pipe is about 5 ft off the ditch bottom at the center of the loop. This distance gradually decreases to where the pipe rests on the bottom of the ditch where the fill has stopped at each end of the loop.

After all the line has been lowered in with the slack loops suspended, the breaks in the section are welded together. This is done by lifting the loose ends clear of the ditch and cutting the pipe to fit in this suspended position. The break is then welded and lowered back into the ditch and covered.

As the initial operation of lowering-in the following morning the slack loops are handled first, and the above procedure is then repeated.

These loops also induce slack into the line that will compensate for pipe temperatures that will be lower than the pipe when it was buried. During the cold winter months it is not difficult to complete the lowering-in of the pipe at temperatures of 50°F or less, but during the hot spring and summer months the pipe may be 70° when it is buried.



Longitudinal Stress

Should a pipeline be buried at 70° without any slack and the pipe temperature lowered to 40°F, this difference would induce a longitudinal tensile stress of 6000 psi. This stress would increase by 30% the longitudinal tensile stress of 18,000 psi due to an internal pressure of 800 psi on a 30-in. OD pipeline of .335-in. wall thickness.

The elimination of this additional stress is the primary purpose of the slack loops.

In rolling or rough country the frequency of slack loops is greatly reduced, as all of the bends act as expansion joints to relieve the stresses that will be induced by temperature changes. All bends are fitted so that the sags fit snug against the ditch bottom, while the overbends stand above the ditch bottom and the side bends fit against the outside curve of the ditch. The survey party that stakes the bends adds a small deflection to the overbends, thereby insuring that they will not touch the bottom of the ditch at the apex of the overbend.

Measurements and observations were made on two sections of pipeline during lowering-in operations. The pipe temperature was recorded by recording thermometers whose bulbs were inserted into thermowells in the pipe.

Each section of pipeline was measured in length while resting on the skids before being lowered in. Reference points were established at each end of the section end in between the location of loops.

Reference Points

On the first section, the reference points were established at a pipe temperature of 85°F and the temperature of the pipe at the beginning of lowering-in was 50°F, while it was 55°F at the end of the operation. Within 30 minutes after the pipe had been covered the pipe temperature rose to 70°F and remained at this tmeperature during a 24-hour check. This corresponds with the 70°F ground temperature, which was measured for a 24-hour period. This section was originally 3000 ft long, with three loops placed between the breaks in the end of the section. The slack loops were located 750 ft apart with 350 ft of fill anchoring the pipe between loops. The reference points were checked after the pipe was lowered-in with the slack loops suspended; the length of the section between the end points had contracted 14 in.

Contours of the loops were made to determine the amount of slack per loop. On an average the loops approximated

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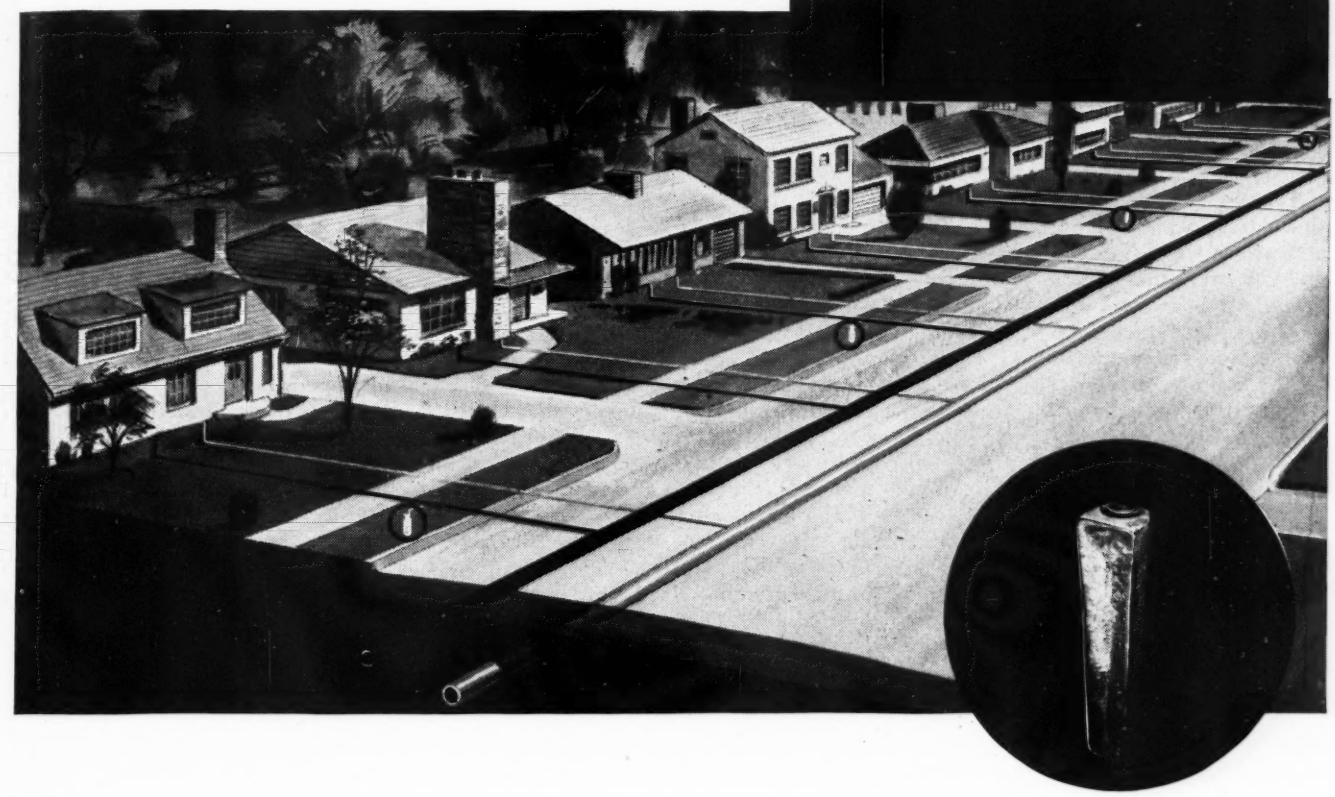

Underground distribution systems can now be protected from corrosion without accelerating metal loss on adjacent structures. Here is a case where leaks were effectively reduced with a low-cost, easily installed system of Dowell Magnesium Anodes.

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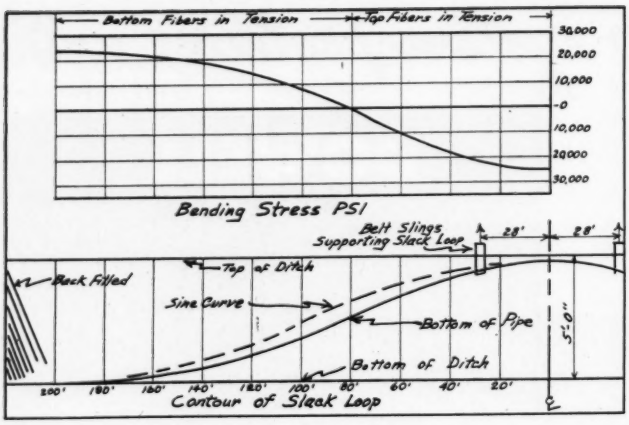

Fig. 1. Contour of average slack loop, and bending stress.

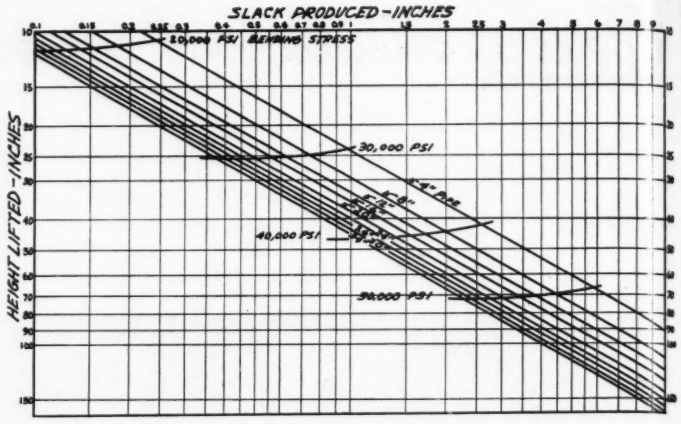

Fig. 2. Slack length and maximum bending stress produced by lifting pipe at one point.

sine curves whose amplitude is 2.5 ft and whose wave length is 400 ft. This yields a curve that is 2 in. longer than the 400-ft base. In other words, each loop would produce 2 in. of slack. The remaining 8-in. contraction was caused by the cooling of the section from the temperature at which the pipe was measured.

Rechecking

The reference points were again checked after the breaks had been welded and buried. There was no measurable movement of the line. The next morning the slack loops were lowered in at a pipe temperature of 55°F. The reference points were again checked and no movement could be noticed. It would seem, therefore, that the original 350 ft of fill between loops is adequate to anchor the line and retain the compression set up by the slack loops.

Observations of the reference points, after lowering-in had been completed, indicated that the pipe lay in the ditch in a snaky fashion. The pipe that was anchored between slack loops tended to crowd the side of the ditch where the back-fill was located, while the slack loops after lowering-in rested hard against the opposite wall of the ditch. The portion of the pipe at the midpoint of the loop was observed to stand slightly off the ditch bottom before the pipe was covered, but after covering the pipe rested on the ditch bottom. It is believed that the soil friction retains the compressive stress within the original length of the slack loop until the line is put into operation and the internal operating pressure causes the line to "work," thereby distributing this compression stress along the line.

On the second section, which was 3600 ft in length, the original measurements were made at 120°F. Again the temperature during lowering-in and placing of the slack loops was 55°F. The check of the end points indicated that the line had contracted 24 in. Six inches was accountable by the three slack loops, while the remaining 18 in. of contraction was caused by the 65° drop in pipe temperature.

The loops in this section were placed about 1000 ft apart. The anchored portions were covered with about 500 ft of back-fill. Again the average slack loop contour was that of the sine wave as previously described, yielding approximately 2 in. of slack per loop.

The pipe in the second section displayed the same general pattern as that in the previous section. Again the portions of the line that had been the suspended slack loops did not rest on the bottom of the ditch. The pipe was also observed to lay in the ditch in the same general snaky arrangement.

The welds that are made connecting each break in a section essentially become slack loops as these welds are cut and made while the pipe is suspended out of the ditch. After the weld has been made and lowered into the ditch the pipe snaked in the same general fashion as the slack loops.

12 Inches Per Mile

Now with slack loops being placed every 1000 ft, with tie-in welds being made every 3000 to 4000 ft, there is approximately 12 in. of slack induced into the line every mile of pipeline.

This 12 in. will tend to relieve the longitudinal tensile stress set up in the line by a 30° drop in temperature below 70°F, which is the maximum temperature during lowering-in of the pipeline. This may be illustrated by the fact that one mile of pipeline that experiences a drop of 30° in pipe temperature, if allowed to contract unrestrained, will shorten by 12 in.

There is a general belief that, once a line has been under operation for two years, the longitudinal tensile stresses which result from lowering of the pipe temperature below that when it was installed will be minimized by the increase of soil friction as the fill packs more solidly around the pipe. This argument is backed up by experiences on most pipelines, in that the majority of line failures occur during the first two years of line operation.

Fig. 1 is the contour of the average slack loop as used in the 30-in. line. Above the contour is an approximate value of the bending stresses produced in the slack loop caused by suspending the loop at two points as shown. These values are approximate as they were obtained graphically from the following relations:

(1) $M = \frac{d^2y}{dx^2} \times E I$

(a) M is Maximum Bending Moment

(b) E is Modulus of Elasticity of Steel $E = 30 \times 10^6$

(c) I = Moment of Inertia of 30-in. OD .335-in. wall thickness pipe

$EI = 1.031 \times 10$ in.

(2) $S = M \div \frac{I}{C}$

(a) S = Maximum Bending Stress

(b) $\frac{I}{C}$ is Section Modulus of 30-in. OD .335-in. wall thickness steel pipe = 229

Fig. 2 is a graph borrowed from the analytical reductions made by the Southern Counties Gas Co. and loaned to this company as an aid in the preparation of this paper. This graph covers pipe sizes from 4-in. to 30-in.

It will be noted in *Fig. 2* that the maximum bending stress produced by lifting 30-in. pipe 60 in. high at one suspension point for a slack loop is approximately 45,000 psi, while in *Fig. 1*, with the same condition prevailing except for the two suspension points as shown, there is only 25,000 psi bending stress.

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Centrifugal Compressor Stations Prove Efficient, Economical, Dependable

By E. A. Koenig

. . . 16 electric motor-driven booster stations operate along Texas Eastern Transmission's pipeline system . . .

IN the design of a natural gas pipeline system, the volume of gas handled, load factor, spacing between stations, line pack requirement, fuel used in operation, cost of operation and maintenance, cost of construction, all involve a process of calculating the best or most economical arrangement that should govern the design. Often, however, this design would or could become inadequate before the proposed system is completed. Future expansion should be incorporated into the design plans where possible.

In designing our system, the engineering department began with a 142-MMcf rate. This was the pipeline delivery capacity without compressor stations. A systematic expansion followed, with one centrifugal and one reciprocating station. This was the use of the first centrifugal compressor to go into continuous main line operation, pumping gas at 550 lbs suction and 670 lbs discharge pressure, and began in October 1947. During November 1947 the rate of throughput was more than 200 MMcf per day with these two stations. In April 1948, we had seven centrifugal stations and three reciprocating stations running, with a capacity of 340 MMcf per day.

Today we have 16 centrifugal compressor stations, all of which are electric motor driven, directly connected to 3600 rpm electric motors. These vary in sizes, ranging from 1250 hp to 2000 hp each, making a total of 188,500 hp in the 16 stations. There are also 10 reciprocating stations, with a total of 88,900 hp for these stations. This gives a total of 277,400 hp in stations pumping gas, with a system capacity of 740 MMcf per day.

TABLE 1

1950	Unit Hrs. Potential	Unit Hrs. Actual	Per cent On-Line Time	Per Cent BHP Load	Total Oil Used
Mar.	4,464	4,458	99	108	32
Feb.	4,032	4,024	99	107	34
Jan.	4,464	4,464	100	107	30
1949					
Dec.	4,464	4,464	100	105	41
Nov.	4,320	4,320	100	105	43

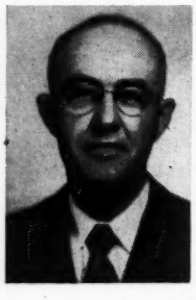
Dependability of electrically driven centrifugal stations is answered in this way. We have 107 centrifugal compressors of which number we have many machines that are running with 99 or 100% on-the-line time month after month, with loads on individual machines of well over 100%. Also, we have machines that have not been off of the line for repairs of any nature, but which are given routine inspections. One of these stations has required only 4½ gal. of oil for a total of 2049 unit hours in one month. The total oil used on our system by centrifugal compressors in one month is only 869 gal. for 56,253 machine unit hours. It seems reasonable to expect a maximum of 500 to 600 gal. in total oil consumption when running 107 centrifugal compressors or 188,500 hp in a month's time. For example, one of our oldest six-unit stations consisting of six units and a total of 9250 hp operates as shown in *Table 1*.

The following comparison will be of interest and is based on 2000 hp units for centrifugals, two 1000 hp reciprocating units, and is the total oil consumption per month:

Centrifugal	5 gal.
Ideal Reciprocating	300 gal.

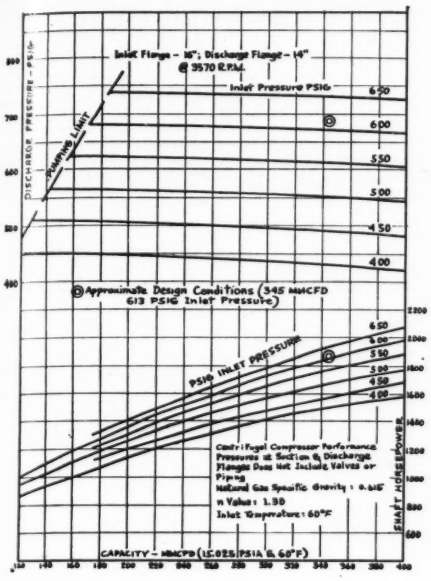
Repairs of centrifugal compressors are relatively simple inasmuch as the unit can be completely overhauled in a single day with four men.

The data and curves to be shown are based on current operating information. In a general way, in our discussion, we intend to make certain comparisons based on these data. Please bear in mind that comparisons can vary as improvements in design are forthcoming. The best operation is, of course, to be expected when the characteristics of the

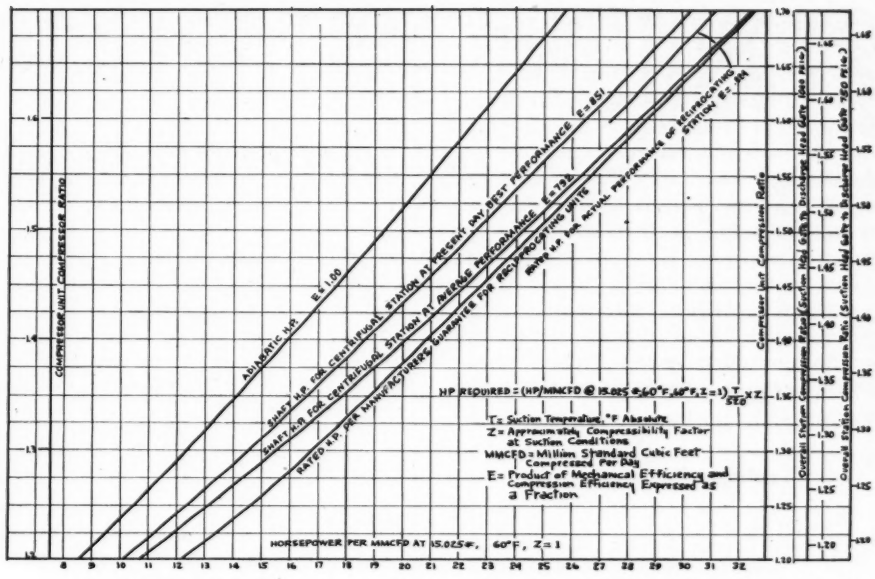


EDGAR A. KOENIG was graduated from Texas A&M college in 1925 in mechanical and chemical engineering. He has been at work in the gas industry ever since with Magnolia Gas Co., Magnolia Petroleum Co., Socony-Vacuum, in private practice as a consulting engineer, and with Texas Eastern Transmission Corp., of which he is presently general superintendent.

Mr. Koenig holds patents on several gas engineering developments, including a scraper and settling tank for products lines, station pressure control instruments, and pipeline shutoff and plugging tools.



GRAPH 1. Pressure-volume-power, for a design of 345 MMcfd.


COMPRESSOR UNIT COMPRESSION RATIO
ADIABATIC H.P. E = 1.00
SHAFT H.P. FOR CENTRIFUGAL STATION AT PRESENT DAY BEST PERFORMANCE E = 85%
SHAFT H.P. FOR CENTRIFUGAL STATION AT AVERAGE PERFORMANCE E = 75%
RATED H.P. PER MANUFACTURERS GUARANTEES FOR RECIPROCATING UNITS
SHAFT H.P. FOR ACTUAL PERFORMANCE OF RECIPROCATING STATION E = 85%
HP REQUIRED = (HP/MMCFD @ 15.025 #, 60°F, 14.65 #, Z = 1) T/520 X Z
T = Suction Temperature °F Absolute
Z = Approximate Compressibility Factor at Suction Conditions
MMCFD = Million Standard Cubic Feet Compressed Per Day
E = Product of Mechanical Efficiency and Compression Efficiency Expressed as a Fraction
HORSEPOWER PER MMCFD AT 15.025 #, 60°F, Z = 1
Overall Station Compression Ratio (Suction Head Gate to Discharge Head Gate 750 P.S.I.)

GRAPH 2. Horsepower per MMcfd @ 15.025 lbs, 60°, Z = 1.

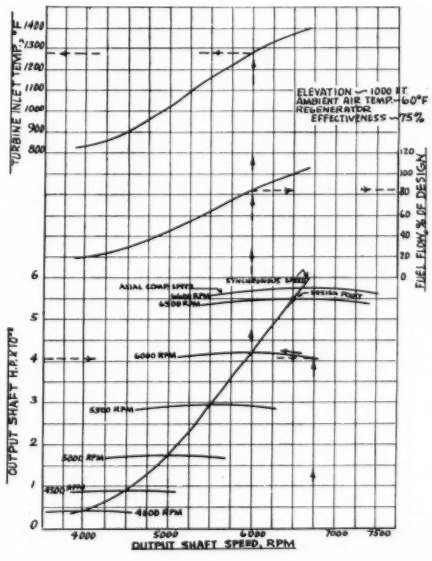
power delivering machine, power consuming machine and the load are all effectively matched. This is one of the most difficult problems facing the engineer and one where great dependence is placed on properly judging the operating conditions to be presently expected as well as those to be anticipated.

Here we must outline our problem and fix the limitations within which we intend to work, with due allowance for normal development. The attached curves are based on the performance that we are actually experiencing today and are arranged to give a comparison between the operation of reciprocating and centrifugal machines. The reciprocating machinery data are based upon the same type and make of engine.

Centrifugal Compressors

In discussion of the centrifugal compressor, let us look at *Graph 1:* Pressure-Volume-Power, for a design of 345 MMcfd. The upper left-hand margin is "discharge pressure" (psig) and we notice a slope dash line (pumping limit). To the right of the pumping limit are the suction pressure curves corresponding to capacity at the bottom of the graph and the resulting discharge pressure at the upper left. For example, with 613 psig suction and 687 psig discharge pressure, you would have a capacity of 345 MMcfd. In the lower part of this graph we find suction (inlet) pressure curves, and in the right hand margin, shaft horsepower. At 613 psig suction and 345 MMcfd, approximately 1870 hp would be required. We would, no doubt, choose for this condition a 3600 rpm motor of 2000 hp, capable of 10 or 15% overload continuous rating.

To the left of the slope line (pumping limit), it would not be advisable or practical to operate, either at 120 MMcfd and about 475 psig discharge, or at 190 MMcfd and approximately 737 psig discharge. This is because it is below the designed capacity of the machine at a constant speed of 3570 rpm. However, with a variable speed drive, it would be possible to vary the head and volumes over a wider range than with a constant speed drive. When a constant speed drive is used, such as an electric motor drive, the volume can be varied from approximately 180 MMcfd to capacity, 345 MMcfd, or beyond design to 400 MMcfd, or more, if the shafts and motor will take the additional load. Allowance could be made for this in the compressor shaft and motor overload in the design of the station.



GRAPH 3. Estimated performance of a gas turbine unit.

So, it would be possible to go from about 50% capacity to 100% capacity and as far beyond 100% capacity as practical—at least 110 to 115%, if the design allowed for such conditions at constant speeds. This range in capacity could well accomplish everything desired of the pipeline and station design in capacity requirements.

Reading the Graph

Let's look at *Graph 2:* Horsepower per MMcfd @ 15.025 lbs, 60°F, Z = 1.

The left-hand margin refers to compressor "unit compression ratio." The bottom of the graph refers to "horsepower per MMcfd at the stated condition, uncorrected for compressibility." To obtain the true horsepower required per MMcfd compressed, the reading on the lower scale must be corrected for compressibility and temperature as shown in the equation. The right hand margin of the graph also gives "compressor unit ratio" on the first scale; "over-all station compression ratio" (suction head gate to discharge head gate) at 1000 psig discharge pressure, allowing 5 lbs piping drop on each side of the compressor, in the second or middle scale; "over-all station compression ratio" (suction head gate to discharge head gate) 750 psig discharge pressure, also allowing 5 lbs piping drop on each side of the compressor, on the third scale. Beginning with the left hand curve, we represent adiabatic hp, E (Compressor Efficiency) = 100%, theoretically.

The next curve to the right represents

"shaft horsepower for centrifugal station at present day best performance," with product of mechanical and compression efficiency, which includes allowance for pressure drop through piping and valves between stages of compression, E = .851. The next short curve near the top gives rated "horsepower for actual performance of reciprocating station," E = .824. The next curve to the right gives "shaft horsepower for centrifugal station at average performance," E = .792. The next curve or bottom curve gives "rated horsepower per manufacturer's guarantee for reciprocating units."

Turbine Performance

Referring to *Graph 3*, it shows an estimated performance of gas turbine unit and can best be explained in the following manner:

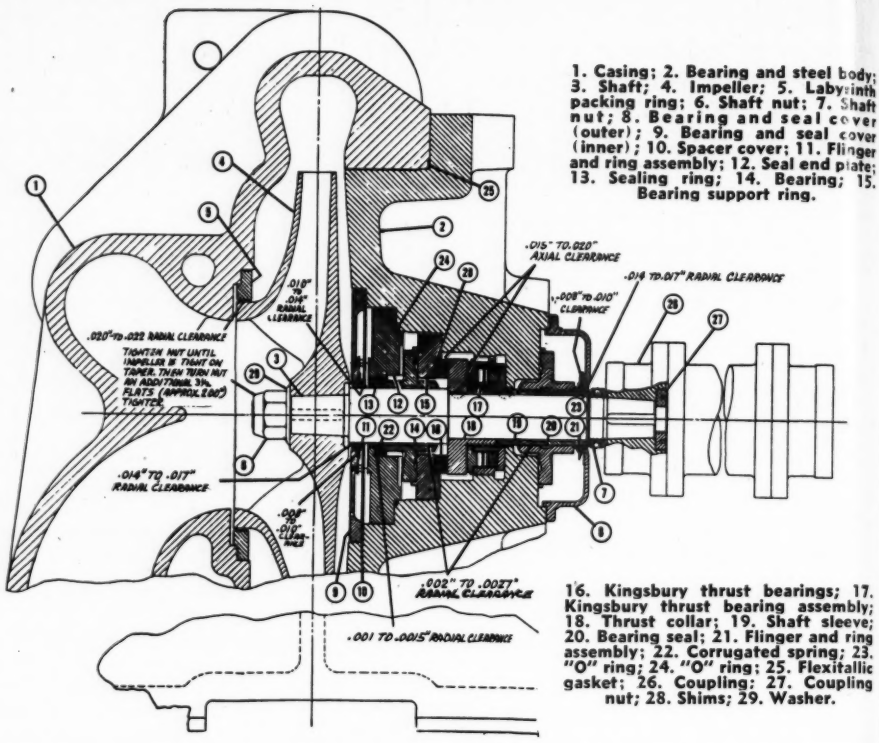
1. Assume operation with a power output of 4080 brake horsepower at an output shaft speed of 5950 rpm. This corresponds to a synchronous speed condition. The fuel flow, from the curve, is 81.3% of that at the design condition. The thermal efficiency at this point may be calculated from the following:

$$\text{Thermal Eff.} = \frac{\text{BHP}}{5500} \times \frac{\text{Design Thermal Eff.}}{\%\text{ of Design Fuel Flow}}$$

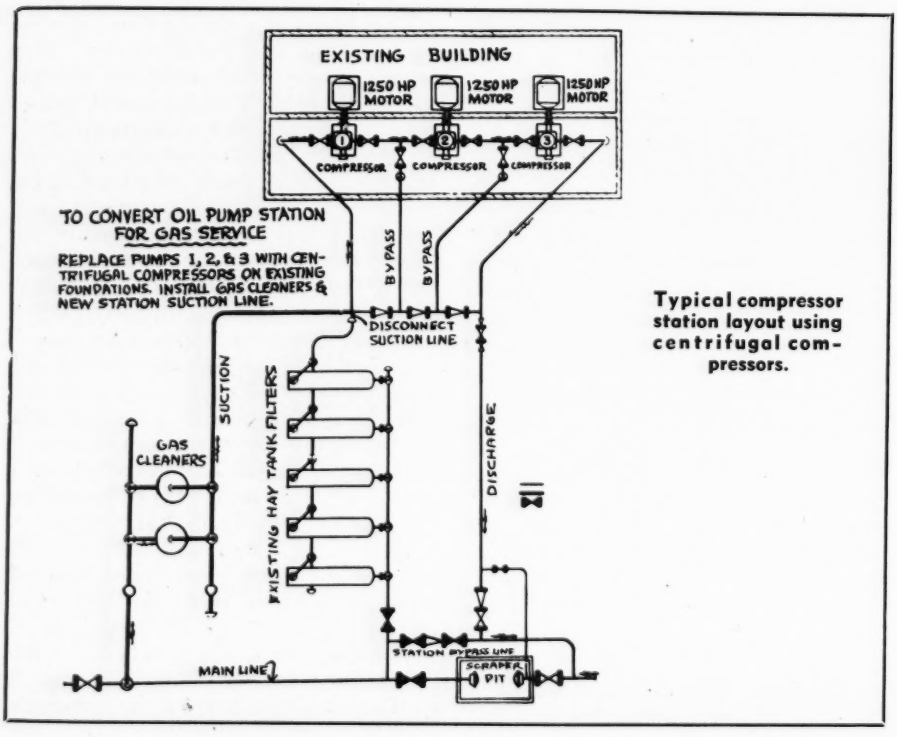
$$\frac{4080}{5500} \times \frac{28}{.813} = 25.2\%$$

If a thermal efficiency of 28.0% at the design condition is assumed, although somewhat higher values are anticipated, the corresponding thermal efficiency is 25.2%, with a turbine inlet temperature of 1270°F.

2. Assume operation with a power output of 4080 rated horsepower at an output shaft speed of 6750 rpm. The corresponding axial flow compressor speed is 6000 rpm. Because of slight changes in component efficiency at other than the synchronous speed condition, it is necessary to provide a fuel flow equivalent to 4220 hp at the synchronous speed condition. The resultant thermal efficiency at this speed condition is 24.75%, or 0.45 points lower than obtainable at synchronous speed for the same power output. The turbine inlet temperature required is 1280°F.


1. Casing; 2. Bearing and steel body; 3. Shaft; 4. Impeller; 5. Labyrinth packing ring; 6. Shaft nut; 7. Shaft nut; 8. Bearing and seal cover (outer); 9. Bearing and seal cover (inner); 10. Spacer cover; 11. Flinger and ring assembly; 12. Seal end plate; 13. Sealing ring; 14. Bearing; 15. Bearing support ring.
16. Kingsbury thrust bearings; 17. Kingsbury thrust bearing assembly; 18. Thrust collar; 19. Shaft sleeve; 20. Bearing seal; 21. Flinger and ring assembly; 22. Corrugated spring; 23. "O" ring; 24. "O" ring; 25. Flexitallic gasket; 26. Coupling; 27. Coupling nut; 28. Shims; 29. Washer.
.014" TO .017" RADIAL CLEARANCE
.020" TO .022 RADIAL CLEARANCE
.002" TO .0027" RADIAL CLEARANCE
.001 TO .0015" RADIAL CLEARANCE

TYPICAL CROSS-SECTION of an Ingersoll-Rand end-suction type centrifugal compressor.



Typical compressor station layout using centrifugal compressors.

I wish to make the following acknowledgments, for if it were not for the assistance and fine work of the following persons, the conception of this paper or the achievement of the good operation as displayed would not have been possible:

W. E. Worley, superintendent of compressor stations, and his staff of personnel and those in the field that have made these good operating records. From their operating records a wealth of data have been accumulated and this was used in preparing this paper.

Also, if it had not been for the assistance of Mr. B. D. Goodrich and Mr. C. W. Marvin in preparing the curves and data, it would have been impossible to secure so much information in time to give this paper on "Centrifugal Compressors." This is also true of the assistance received from the manufacturers of equipment, namely, Clark Bros Co. Inc., The Cooper-Bessemer Corp., DeLaval Steam Turbine Co. and Ingersoll-Rand Co.

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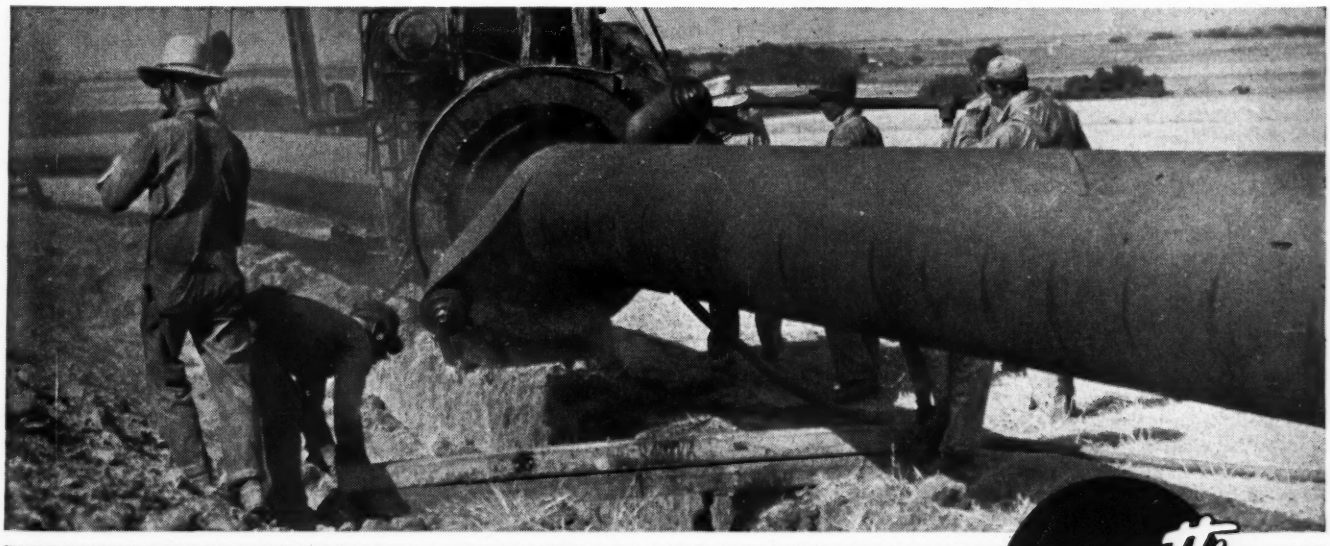

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Imported Natural Gas For Northwest 'Probable'—Manning

Canadian premier has high hopes that gas from Alberta will soon be sent to the rich markets in the U. S. Pacific Northwest

ERNEST C. MANNING (right), premier of Alberta, talks over the chances of early exportation of Canadian natural gas to the U. S. Pacific Northwest with Charles M. Sturkey, Seattle Gas Co., at last month's PCGA convention.

EXPORTATION of natural gas from Canada's Alberta province is no longer a mere possibility—such exportation is now in the "sure thing" category, in the opinion of Ernest C. Manning, premier of Alberta, given in the feature speech at the Pacific Coast Gas Assn. annual convention in Seattle last month.

Five proposed pipeline construction programs which would bring Canadian natural gas to the U. S. Pacific Northwest are still under consideration, Premier Manning said. There is no doubt, he said, that Alberta has more gas than it needs for its own use—reserves are now figured at between 3 and 6 trillion cu ft.

The Alberta government's offiical policy is that since the province is now growing industrially at a rapid rate, assurance of enough gas for its own consumption for a long future period must be made before exportation can be approved. The requirements of other Canadian provinces also must precede exportation of Alberta gas to the U. S. However, since the province is remote from the large industrial areas of eastern Canada, the logical market area for gas in excess of its own needs is the northwestern section of the U. S.

Although Mr. Manning made no commitments, he reported that machinery has been set up to consider the various questions within the general problem of export, and that the Alberta government is anxious to have hearings on the subject completed and to start the exportation of gas.

Last of the proposed pipelines will be discussed in hearings starting Dec. 4. Premier Manning feels that the recent crisis in Korea has pointed up the need for speed in clearing exportation authorizations. The procedure companies must follow to obtain permission to export gas is as follows: First a charter must be obtained from the House of Commons. Next the company applies for a permit to cross provincial boundaries and then for a permit for export.

It is his opinion that Alberta gas will play a major part in defense programs of the Pacific Northwest.

Although no gas has been flared in the province since 1935, it has been estimated that between 1929 and 1939 enough Alberta gas had been flared to supply the Pacific Northwest for 25 years.

Exploration for oil in the province, which had its first boom in 1914, has been the major source of gas discovery. There has been little exploration for gas, itself, in Alberta. Oil exploration is proceeding at a rapid rate now, however, and discoveries of natural gas continue at a higher rate even though oil is the main objective of the search.

In the last three years private oil companies have spent $325 million in Alberta on exploration. Premier Manning believes that development of these resources by private companies will insure a big exploration program that could not be financed under any government subsidy plan.

Oil Over-Production

Until two years ago Alberta had been an importer of fuel oil and now found itself in a position of wanting to become an exporter. Under quotas set up by the provincial conservation board, present production is 170,000 bbl per day. The daily requirement in the eastern portion of Canada, extending to Manitoba and Saskatchewan, is 70,000 bbl a day. Thus, the province has 100,000 bbl to export from its normal marketing area. This condition will be relieved by the oil line now being built from Edmonton to the head of the Great Lakes. This will take 95,000 bbl a day. However, it will not completely solve the surplus situation because during a long stretch in the winter, transportation from the Great Lakes south is impossible because of ice.

Currently, one-third of the province's total revenue of $78 million is contributed through the oil industry.

The economy of the province has changed considerably in recent years. Through development and proper exploitation of natural resources, the province has put itself on a very sound footing financially. In 1935, to meet just the interest on the provincial debt required 51% of total revenue. Today, on a basis of a 23-year amortization, debt interest and principal charges are being paid off and are requiring only 8% of the total revenue. In 1935 total revenue amounted to $16 million; it now amounts to $78 million.

Exportation Plans

Exportation plans which have been submitted to the provincial conservation board in Calgary include those of Northwest Natural Gas Co., which would start in Canada, cross Idaho, and serve Seattle, Portland, and Vancouver; Western Pipelines Ltd., which would run from Alberta to Winnipeg, Manitoba, then south to the Dakotas and Minnesota; Westcoast Transmission Co. Ltd., which wants to build a line 1025 miles long with 119 miles of laterals and 426 miles of gathering lines, from Edmonton to the border and serving Seattle, Bellingham, Tacoma, Olympia, Centralia, Everett, Kelso, Longview, and Camas, Wash., and Portland, Ore.; and Pacific Northwest Pipeline Corp. (the only company to have made a formal application to the U. S. Federal Power Commission), which has a huge pipeline plan for 2175 miles of main line, costing $174 million, and stretching from a point near the Gulf of Mexico in Texas to Vancouver, B.C.

This last proposal, a newcomer in the two-year-old discussions of pipelines to export Alberta gas, provides for a lateral crossing into Canada to tap the Pincher Creek gas field in Alberta. This Alberta gas would augment the 250 MMcf input at the Texas end. Pacific Northwest proposes to serve en route Salt Lake City, Utah; Boise, Pocatello, Twin Falls, and Idaho Falls, Idaho; Portland, Ore.; Seattle, Spokane, Tacoma, and Hanford, Wash.; the atomic energy plant at Arco, Idaho, and Vancouver.

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The current accelerated demand for natural gas for industrial and domestic fuels requires the construction of thousands of miles of high pressure pipelines and the attendant compressor stations. These compressor stations have a major and minor demand for power. The primary and major power demand is that required to compress the transmitted gas. The secondary but important minor demand is that required by the station auxiliaries. The availability and low cost of natural gas make it the logical choice as the source of the compressor station power.

It is universal practice to use large, multi-cylinder, comparatively slow-speed natural gas engines to compress the transported gas. These furnish the primary demand for power. Smaller, industrial, multi-cylinder natural gas engines are particularly suited to economically furnish the secondary power requirements of the station auxiliary equipment, such as circulating pumps, air compressors, cooling fans, electric generators, and fire fighting pumps. These engines range in size from 100 to 3000 cu in. displacement, and in speed from 750 to 2500 rpm. The following discussion is intended as an aid in the selection of engines for application in compressor plant auxiliary service.

By CHARLES B. BRILEY

MOST of us are more familiar with the internal combustion engine in our automobiles than with the engine driving a jacket water pump. We regard 60,000 to 70,000 miles before a major overhaul as good performance for the automobile engine. Based on a figure of 25 miles an hour as an average speed, this engine would run 70,000 miles in approximately four months of continuous operation. We would expect the jacket water pump engine to give a minimum of 16 months service before overhaul. Many engines in this type of service run 2½ to 3 years before requiring overhaul. A life expectancy of ten years is conservative. This is the equivalent of two million miles at 25 miles per hour, and there are engines in operation on this type of service with equivalent service in excess of three million miles.

The major factors governing engine selection for auxiliary equipment are the horsepower and speed requirements of the driven equipment and the type of serviec to which the engine is to be applied. The first consideration is the type of service—whether intermittent or continuous.

For intermittent duty such as fire pumps, standby emergency service and, in some instances, starting air compressors, the engines may be operated for short periods of time at near maximum horsepower and speed. Under continuous load conditions it is essential to load the engine at considerably less than maximum horsepower, and operate at a moderate speed in order to obtain satisfactory service and low maintenance costs.

For the purpose of this discussion engines will be classified by cubic inch displacement. The range will be:

Small	100 to 400 cu in.
Medium	400 to 1000 cu in.
Large	1000 to 3000 cu in.

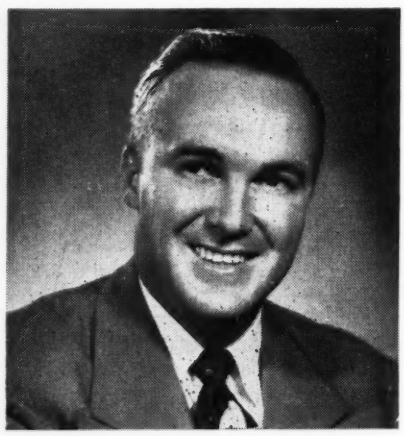
There are three generally accepted methods employed in selecting industrial power units, namely: (1) The Internal Combustion Engines Institute standards, (2) the consideration of brake mean effective pressure and piston speed and (3) API standards.

The majority of engine manufacturers rate their engines according to standards established by the Internal Combustion Engines Institute. These standards specify the equipment to be included on the engine at the time of the test, and establish methods of testing. For intermittent maximum load, the manufacturer must guarantee that the engine will deliver 90% of the maximum power unit rating. Further, these standards state that the maximum power shall be derated by 3% per 1000 ft rise in altitude above sea level, and 1% for each 10° above 60° of the intake air temperature.

In accordance with the ICEI standards, continuous load ratings must not exceed 80% of the maximum power shown on the manufacturer's performance curves. This figure is to be used for altitudes up to 3000 ft. Above 3000 ft deduct 3% for each 1000 ft. For each 10° rise over 60° in ambient air temperature, deduct 1% of the sea level maximum power rating.

The standard net power unit ratings determined by tests under the institute standards are called maximum brake horsepower, and have often been referred to as the "bragging horsepower." While ICEI standards for continuous duty are not generally utilized in the petroleum industry in California, it is my desire to show the source of the published load recommendations.

Common practice is to rate an engine for continuous duty on the basis of 50 lbs BMEP and 1000 ft per minute piston speed. These figures are satisfactory for rating small engines but caution should be used when applying them to engines in the medium and large size range. When an engine is operated below its optimum power and speed range, difficulty may be encountered in maintaining



CHARLES B. BRILEY, sales engineer, Bethlehem Supply Co. of California, is a graduate of Iowa State college. Prior to his naval service in World War II, he was associated with Natural Gas Pipeline Co. of America.

He was engineering and repair officer for diesel-powered Navy ships during the war, and was in charge of the Okinawa repair station for internal combustion engines. His paper was originally presented at the PCGA transmission conference, Santa Maria, Calif.

normal engine temperatures. Low temperatures are liable to create sludge and condensation in the crankcase.

The brake mean effective pressure is theoretical, and I wish to emphasize the "theoretical" value of the mean effective pressure resulting only from the power taken at the output shaft. BMEP does not consider any power used within the engine itself for friction, fan load, and accessories. The formula used to compute BMEP for a four-cycle engine is:

$$\text{BMEP} = \frac{792{,}000\ (\text{hp})}{\text{Displacement (cu in.)} \times (\text{rpm})}$$

It is derived from the single cylinder, two-cycle formula of $\text{hp} = \frac{\text{PLAN}}{33{,}000}$ For small engines the accepted continuous duty BMEP is 50 psi; for medium size engines 60 psi; and for large engines up to 65 psi. For intermittent service there is no recommended BMEP loading because of the wide variance. In one manufacturer's line of engines, the maximum BMEP for intermittent service runs from 70 lbs to 110 lbs with no apparent correlation as to size. Individual engine characteristics determine the maximum allowable loading.

Piston speed is defined as the mean value of piston travel in feet per minute, and is computed from the following:

$$\text{Piston speed} = \frac{2\ (\text{strokes in inches})\ (\text{rpm})}{12}$$

Stress reversals are more important than the speed of the piston along the cylinder wall. For this reason a standard of 1000 ft per minute piston travel cannot be used for all engines. Experience has proven that engines equipped with cast iron pistons can generally be run for continuous duty at the following piston speeds: small engines—1000 ft per minute; medium engines—1200 ft per minute; large engines—1300 ft per minute.

When the speed of the driven equipment necessitates using a higher engine speed than normally recommended, aluminum alloy pistons will lower the degree of stress created at the time the piston changes its direction of travel.

For intermittent operation, piston speeds can range from 1200 ft per minute for small engines up to 1600 ft per minute for large engines. These maximum speeds vary according to the individual models, and it is therefore advisable to obtain the manufacturer's recommendations. Due to individual engine characteristics some engines are known as "low speed sluggers" while others react better at high speeds.

Selecting an engine by BMEP and piston speed establishes a common level for all engines, but assumes all engines equal in load carrying ability. It does not give credit to the manufacturer who has developed an engine capable of a higher BMEP and lower internal losses.

Due to the work of the standardization committees of the American Petroleum Institute, most engine manufacturers now have available observed brake horsepower curves corrected to meet standard condition of temperature (60°) and pressure (29.92 in. of mercury). The API test procedure specifies that the engine be run at least two hours to assure uniform operating conditions and that each speed-power setting be of one-half hour minimum duration. Readings must be taken at five-minute intervals and average values reported.

The API standard curves are:

1. Bare engine maximum brake hp
2. Power unit maximum brake hp
3. API power unit horsepower for pumping units which is 65% of the power unit maximum brake hp
4. Power unit maximum torque

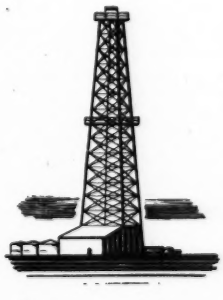
All are plotted against speed in revolutions per minute. Manufacturers recommend minimum and maximum continuous duty speeds and maximum intermittent duty speeds are also placed on these curves.

In adapting the API curves to continuous duty compressor plant engines it is suggested that all size engines be selected on the basis of 60% of the maximum power at the operating speed for continuous duty. This is less than the API rating for oil well pumping, but compressor plant service demands can be more severe. Continuous duty speed for small engines should be 80% of the manufacturer's recommended maximum continuous speed, and for medium and large engines, 90%.

For intermittent service it is possible to utilize 90% of the maximum power unit horsepower and the engine can be run at 90% of the manufacturer's recommended maximum speed for intermittent duty.

The proper compression ratio can increase the efficiency and horsepower of a natural gas engine, while a low ratio causes high exhaust temperatures and reduced valve life. Ratios ranging between 5.5 and 7.1 are satisfactory.

Summarizing the three methods, it is found that the ICEI method establishes standard practice for testing, and designates the equipment to be used on the engine. These standards are widely used for transportation and construction work in which there is an operator readily available in case of engine failure. For use in the oil industry, where the engine is expected to run continuously with a very minimum of service and attention, it is wise to be more conservative in rating for continuous duty.



Rating by BMEP and piston speed is a simple analytical method which gives definite figures for comparison. However, no provision is made for engines of different load carrying capacity, and consequently provides no incentive to the manufacturer to develop an engine capable of higher horsepower and speed.

The API curves show maximum horsepower that can be obtained from engines, and specify the conditions of test. Past experience and service demands in the oil industry is the nucleus around which API continuous duty ratings are built. They are conservative and normally will be found satisfactory.

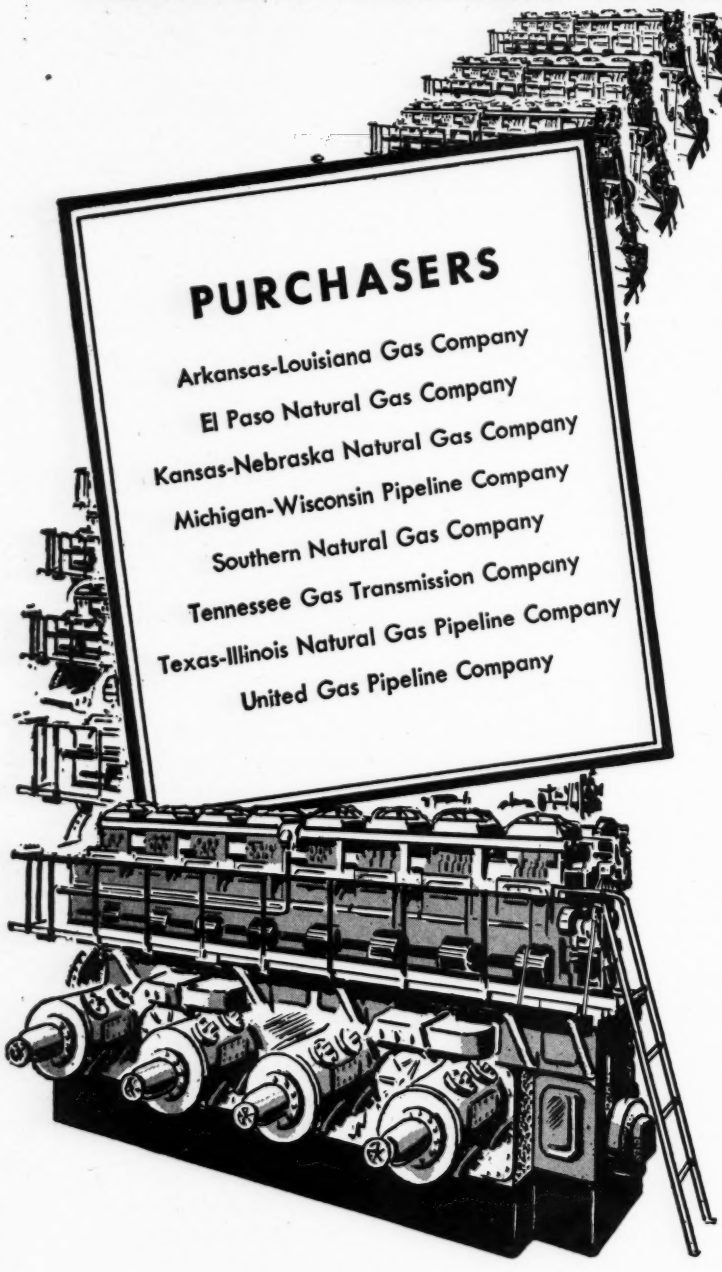
The preceding has been a discussion of the methods used to rate power units. However, the engine will deliver no more power than that required by the driven equipment. The driven equipment dictates the size of the power unit.

Engine power is flexible and can be utilized at various speeds, but some equipment is designed to operate outside the speed range of an engine with sufficient horsepower to carry the load. It is applications such as this that require the use of V-Belt or gear drives. Another possibility is that of splitting the job into two or more units so that the allowable engine speed of smaller models will permit using direct connected units. Where standby units are needed, this practice can be economically attractive by reducing initial costs.

Experience has proven that jacket water temperature is a major factor in engine wear. Operating temperatures of 175 to 185°F have been found ideal. Though higher temperatures might prove beneficial, the tendency of the water to flash to steam at the pump suction has fixed the limit on standard equipped units. These steam pockets can cause a surging action of the cooling water to the extent that a hot spot is developed and suddenly cooled by the inrushing waters. This can cause cracked heads and blocks.

The ideal situation would be for the engine to operate with inlet water of 175° and a 10° pickup through the engine. In actual practice the pickup is seldom less than 20°. The maximum pickup should be regarded as 35° and when this amount is reached immediate steps should be taken to remedy the situation. Lack of uniform jacket water temperatures causes unequal expansion and excessive wear.

QUICK ACCEPTANCE *in the gas transmission field!*



Pipe line companies purchase over 60 Worthington uniflo design TYPE UTC-16 angle gas engine compressors

It takes time — and actual working conditions — to show how equipment stands up. That explains the keen interest of transmission companies and refineries when the first commercial installation of Worthington's new Angle Gas Engine Compressor TYPE UTC-16, was dismantled for inspection. After 2763 hours of continuous operation — under full load and frequent overload — it was found that:

- **All parts were carbon-free,** demonstrating the marked superiority of Worthington uniflo scavenging over conventional loop scavenging for reducing wear.
- **Pistons and liners were still well within shop tolerances,** and the high polish on the entire liner surfaces indicated A-1 operating condition.
- Rings showed minimum wear, with tool marks still visible.
- Bearings were all in perfect condition.

A Success From The Start

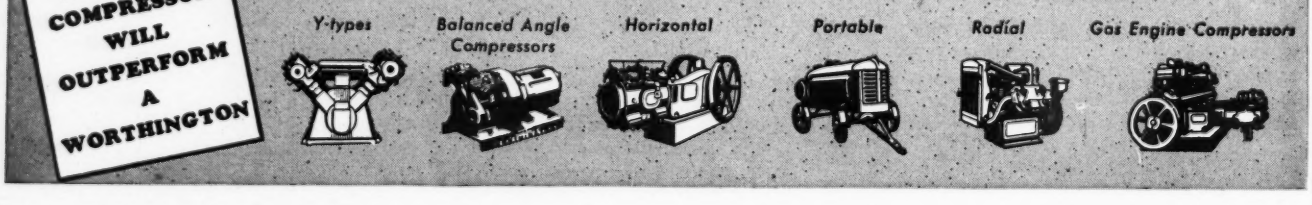
Shop tests had already proved TYPE UTC-16's more thorough scavenging, and perfect combustion. Now, this far more conclusive field test proved the ability to assure these benefits over a long, trouble-free service life. And a steadily growing list of purchasers has established TYPE UTC-16 as a real history-maker in the development of more efficient, more economical gas transmission.

Why not investigate the many advantages of joining this list? Get the whole story that proves *there's more worth in Worthington* from our nearest District Office. Or write to *Worthington Pump and Machinery Corporation, Engine Division, Buffalo, N. Y.*

WORTHINGTON

EK-0-3

NO OTHER COMPRESSOR WILL OUTPERFORM A WORTHINGTON



conditions can be improved and pick-up kept to a minimum by increasing the rate of water flow through the engine. In a compressor plant installation where the engine is cooled from the jacket water system, the use of a large bypass between the water outlet and the pump suction will permit the water pump to deliver its maximum volume and assure full flow through the jackets. Temperatures can be regulated by means of thermostatically controlled valves.

Cooling Engines

Jacket water systems should be designed for pickup of 65 Btu per horsepower per minute. This will help to assure sufficient cooling. When a series of engines is cooled from a common line, make certain that one or more engines are not being starved of cooling water.

Maximum jacket water pressure normally recommended is 10 psi. Too high a pressure can cause leaky gaskets, water in the crankcase, and faulty thermostat operation.

Another source of cooling water troubles is the presence of dirt and sludge in the system. The resultant blocked passageways, scaling and hot spots cause high maintenance costs and are a constant operational headache. Many operators have added rust inhibitors to their water with excellent results. Others have reduced water pump overhauls by the addition of a small amount of water soluble oils to their cooling water.

No engine can be expected to pull the load if it is starved for fuel. Many times small diameter lines of insufficient capacity are run to engines and cause burned valves and fail to give satisfactory service. This can be easily prevented by using larger fuel piping and placing a pressure regulator capable of passing 15,000 Btu per hp-hr at each engine. The engine will not use this total amount but this volume will prevent surging and be insurance against an insufficient fuel supply.

Ignition Maintenance

Ignition systems normally require more maintenance hours than any other accessory on the engine. By periodically checking plug gaps and timing, the maintenance costs can be appreciably reduced. The best magnetos will break down eventually, but by using recommended spark gaps the magneto's load can be reduced and its life lengthened.

A paper by E. R. Rutenber of the Waukesha Motor Co.* contained the following interesting data. Tests conducted by his company relative to the effects of dust on the service life of an 815 cu in. displacement engine revealed that 4.7 grams of dust injected into the air inlet

would wear the engine excessively in 50 hrs. When 8.3 oz of dust had passed through the engine, no matter whether it took 100 or 10,000 hrs, the engine was worn enough to cause spark plug fouling due to high oil consumption. The use of efficient air cleaners is very important. They should be serviced often and in areas where excessive dust is encountered, such as some sections of the San Joaquin valley, it is wise to service the cleaners every 24 hrs, and sometimes every 8 hrs.

Other Accessories

Other standard accessories normally used on compressor plant engines are oil filters, safety switches, governors, and water cooled exhaust manifolds. There are numerous types of oil filters available and the choice depends upon the type of oil used. The use of larger filters allows longer operation between filter changes. The limiting factor on filter life is how much sludge and dirt the filter will hold before becoming saturated. There has been noted a recent tendency toward larger filters and also the use of a full flow filter in which all of the oil is filtered rather than that which is bypassed by the pressure regulating valve.

Clean oil is a definite aid to lower maintenance cost, and periodic servicing of the oil filters is essential. There are several types of safety switches available for interrupting or grounding the ignition system in the case of low oil pressure or high water temperature. They cost very little to install, and can save very expensive overhaul jobs. Safety switches have become standard equipment on nearly all California oil field and compressor plant engines.

The standard speed governor has a regulating ability of approximately plus or minus 5%, which has proved to be close enough for most compressor plant operations. Where closer regulation than this is required, special governors are available which will permit from 1 to 2% regulation.

Many plant operators have standardized on the use of water-cooled exhaust manifolds as a safety measure to prevent fires and to avoid men receiving bad burns. The water-cooled manifold also prolongs valve life by removing excess heat from exhaust port areas. When a water-cooled manifold is used in conjunction with a radiator-cooled engine it is usually necessary to install a heavy duty radiator and occasionally install a fan capable of higher air volume.

Inexpensive dial type instruments that will aid the plant operator can be supplied by engine manufacturers. These usually are contained in a panel board which includes the following: Jacket water temperature gauge, oil temperature gauge, oil pressure gauge, intake manifold vacuum gauge, and tachometer. The value of the intake manifold vacuum gauge cannot be overrated. It indicates the loading on the engine and is the first to show any change in engine operation. The other gauges are self-explanatory.

Where there is more than one engine in a locality it has become general practice to start them with one group of batteries which can be mounted on a small cart or truck to facilitate moving from engine to engine. The connection is made to the engine through a cannon receptacle. This eliminates having a battery and generator for each engine and lowers maintenance cost. Wherever compressed air is available there has been an indicated trend toward the use of airstarters. This has eliminated fire hazards of electric starting and the headache of battery maintenance. A recent development, which has been thoroughly tested and proven satisfactory, is an alternating current starter for 110 and 220-volt operation.

Applications

There are many applications to which the natural gas engine is well suited, and with proper installation, selection, and maintenance, the engine will give a creditable performance. When selecting engine driven equipment it is usually profitable to consult the engine supplier. He has had experience in selecting engines to do specific jobs, and can be of aid in matching the engine to the driven equipment. Usually the engine will be the more expensive and the more complicated of the two pieces of equipment; therefore, all factors should be considered when selecting and applying it. Engine manufacturers are constantly striving, through research and experimentation, to develop internal combustion engines at less cost. High strength, light weight alloys are being used to increase the allowable speeds and cut down the engine weight. Compression ratios have been increased along with higher maximum BMEP.

Being cognizant of the high standards natural gas engines have attained in the past; knowing the constant research being made for still better achievements, those of us who sell natural gas engines cannot help being enthusiastic regarding their future.

*Presented at the tractor and power meeting, Society of Automotive Engineers, Los Angeles, June 7, 1945.

NEW ENGLAND BRIEFS

Filing set for Sept. 1 as speedup ordered

In an effort to speed the arrival of natural gas in New England, the Federal Power Commission ordered on Aug. 10 that intermediate decision procedure be omitted, oral argument be waived, and briefs be filed by Sept. 1 on applications of Tennessee Gas Transmission Co., Northeastern Gas Transmission Co., Transcontinental Gas Pipe Line Corp., New York State Natural Gas Corp., Niagara Mohawk Power Corp., and to a limited extent on Algonquin Gas Transmission Co.

Algonquin's proposal was consolidated with Northeastern's application on July 24. At the same time, the commission denied a motion of the National Coal Assn. and others seeking to have two applications involving Texas Eastern Transmission Corp. consolidated with the hearing. One of Texas Eastern's proposals is for construction of facilities which will be used, in part, to furnish gas to Algonquin. The other, filed jointly with New York State Natural, requests permission to develop storage facilities in Pennsylvania.

Both Algonquin and Northeastern want to build natural gas systems in the New England area. Tennessee Gas and Transcontinental would supply Northeastern's gas requirements, New York State Natural and Niagara Mohawk would build pipeline facilities in New York state, and Tennessee would supply gas to New York State Natural for resale to Niagara Mohawk.

Part of Mississippi Plea Approved, Part Denied

Part of Mississippi River Fuel Corp.'s (St. Louis) proposed expansion program has been approved by the FPC, but proceedings with regard to the firm's natural gas supply will be resumed at a later date. Facilities authorized will increase the system capacity from the presently authorized 266 MMcf per day to up to 300 MMcf per day. Mississippi's overall plan was to increase its capacity to 375 MMcf.

Approved construction consists of a 40-mile, 18-in. line from near Dubach, La., to the Perryville, La., compressor station, a short 24-in. line, and a Mississippi river crossing in St. Louis. The company also may continue to operate additional compressor units totaling 4100 hp at Perryville and West Point, La., stations. These units have been in operation since late 1949 without FPC authorization, an "apparent violation of the Natural Gas Act." FPC said the U. S. attorney general will consider whether criminal proceedings should be instituted.

Total estimated cost, including the compressor units already in operation, is about $3.1 million. New facilities are to be placed in operation by Dec. 31.

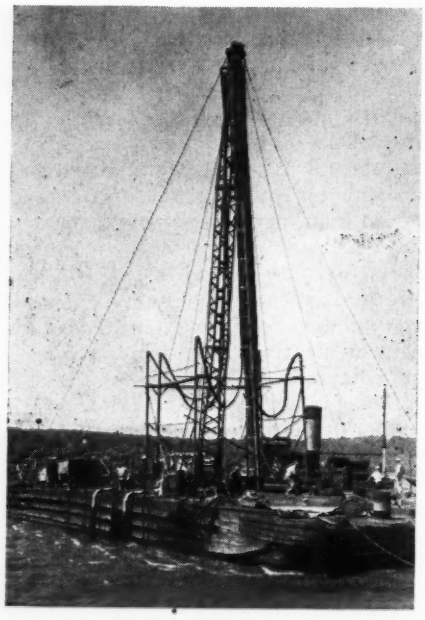
The commission rejected Mississippi's plan to lease seven compressor stations to be built by Stupp Bros. Bridge & Iron Co. The company wanted to lease the stations for 28 years, with option to extend the lease for another 10 years, with provision for fixed rentals "per $1 million contract price" ranging from $63,000 per year during the first five years to $42,000 per year during the last eight years. Mississippi described the contract price as actual cost of facilities plus 5%, allegedly to cover Stupp's overhead. FPC said the plan is equivalent to the issuance of 100% debt securities, with the lease rentals representing a binding fixed charge on Mississippi of higher priority than interest on its first mortgage bonds.

Doubling of Michigan-Wisconsin Capacity Gets Final Approval

Final authorization has been granted Michigan - Wisconsin Pipe Line Co. and Michigan Consolidated Gas Co., Detroit, for expansion of the former's system to almost double annual sales capacity. Temporary approval was given by the FPC on June 28.

Annual capacity of the Texas-to-Michigan line will be increased from 56,575 MMcf to 110,595 MMcf, and daily sales capacity will be upped from 155 to 303 MMcf. In a concurrent order the commission authorized Michigan-Wisconsin to lease from Michigan Consolidated and operate existing and proposed storage facilities in the Austin and Goodwell fields in Michigan.

The order granting final permission to execute the plan required Michigan-Wisconsin to sell gas to Iowa Southern Utilities Co. for resale in Centerville, Iowa. A number of other gas companies were denied requests for service.



Mounted on this 256-ft barge, a 115-ft steel spud is furrowing the Hudson river bottom from Edgewater, N. J. to 134th street, New York City, carving out a resting place for the Transcontinental line. The spud is lowered through a well to the river bed, where high pressure jets are blasting a 25-ft pipe trench.

New Evidence to be Heard in Southeast Gas Cases

Threshed over and generally mauled for some three-and-a-half years, the question of whether the Florida-Georgia area will receive natural gas — and from whom — is being dragged out of the FPC closet this month for another inspection, and perhaps further kicking about.

Hearing has been set by the commission for Sept. 25 in the combined dockets of Atlantic Gulf Gas Co., Southern Natural Gas Co., and United Gas Pipe Line Co. "to permit each of the parties to introduce such further evidence as it deems appropriate on all issues in support of each respective application."

In announcing the reopening of hearings "in the public interest," FPC served a reminder that on May 26 it ordered the presiding examiner to "certify to the commission the entire record . . . so as to enable the FPC to determine appropriate future procedure in the proceedings in accordance with the commission's rules."

Previously the Atlantic Gulf case had been reopened April 17 for filing of briefs, and before that, after a two-year delay, hearings started Sept. 20, 1949, and were recessed on Feb. 15, 1950.

United Gas Pipe Line Co., a subsidiary of United Gas Corp., Shreveport, proposes to build 224 miles of line from Louisiana to deliver gas to another subsidiary, Atlantic Gulf, for further transportation to Georgia-Florida-South Carolina cities. Southern Natural would lay a line from Mississippi east to serve similar areas.

Massachusetts Solons Get Bill for State-Owned Line

A bill which would set up a three-man Natural Gas Authority with wide powers to construct gas lines and to collect "rent" for their use by private interests is pending in the Massachusetts legislature and has been referred to a committe for recess study.

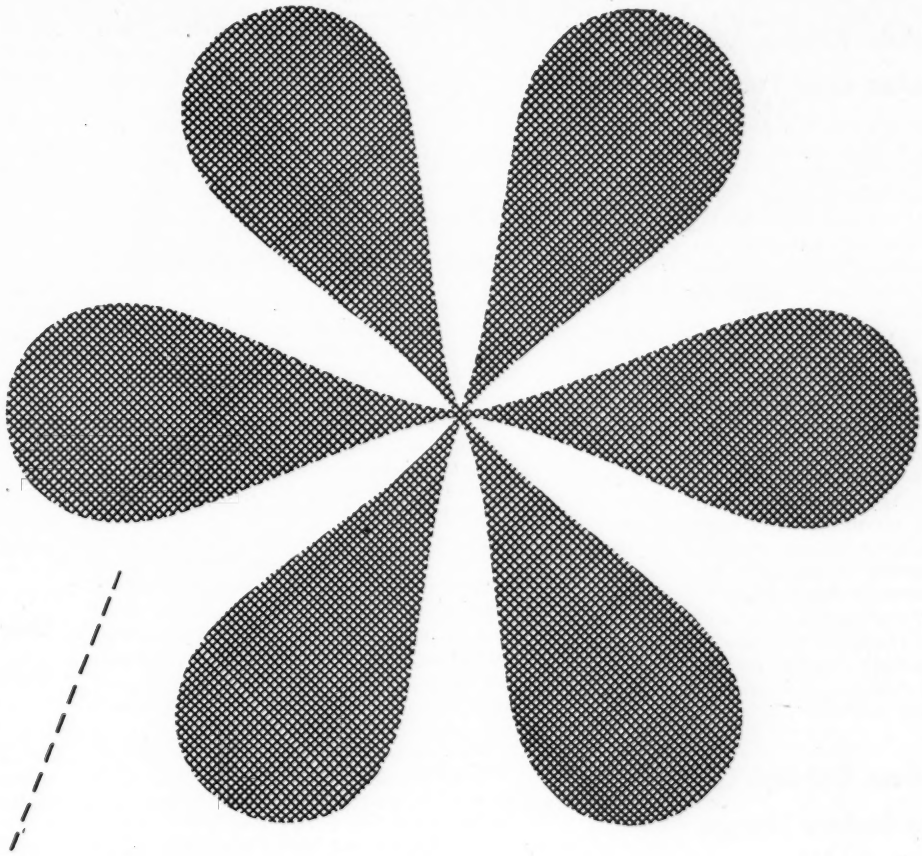
Members would be appointed by the governor and would receive $20 a day and expenses for their services. Up to $25 million in bonds could be issued by the authority, but it is provided that the bonds would not be a pledge on the credit of the state.

Another bill, currently tabled in the state senate, would prohibit distribution companies from holding stock or having officers or directors in the natural gas transmission companies.

More Gas for Washington

Prince George's Gas Corp. has received FPC authorization to construct and operate a 20-mile, 22-in. line costing $1.4 million, to transport gas from Atlantic Seaboard Corp.'s facilities for delivery to its parent, Washington (D.C.) Gas Light Co., and to another subsidiary, Washington Gas Light Co. of Maryland.

The facilities authorized will have an ultimate delivery capacity of 122 MMcf daily, which is required to meet demands for service in the District of Columbia and adjoining areas of Maryland and Virginia.



Footnote that speaks volumes

Here's one time when an asterisk refers to a really *important* footnote.

For the pipe dimensions listed below provide evidence that Kaiser Steel can meet practically every transmission pipe requirement of the petroleum, gas and water industries in the Western two-thirds of the nation!

Kaiser Steel pipe is manufactured to latest API and ASTM specifications—in diameters from ½ inch to 30 inches, and in lengths up to 40 feet. Shipping points are Fontana and Napa, Calif.

It's good business to do business with

Kaiser Steel

*** KAISER STEEL PIPE SPECIFICATIONS • All pipe manufactured to latest A.S.T.M. and A.P.I. specifications**

Type	Diameter	Length	Wall Thickness	Shipping Point
Continuous Weld—Threaded and Coupled	½" to 4" nominal I.D.	Uniform 21'	Standard	Fontana, Calif.
Continuous Weld—Plain End	2⅜" to 4½" O.D.	Up to 40'	Standard	Fontana, Calif.
Electric Resistance and Fusion Weld—Plain End	8⅝" to 22" O.D.	Up to 40'	.188" to .500"	Napa, Calif.—Basalt-Kaiser
Electric Resistance Weld—Plain End	5⅛" to 12¾" O.D.	Up to 55'	.188" to .400"	Fontana, Calif.
Electric Fusion Weld—Expanded—Plain End	24" to 30" O.D.	Up to 40'	.188" to .500"	Napa, Calif.—Basalt-Kaiser

Prompt, dependable delivery at competitive prices • KAISER STEEL CORPORATION Los Angeles, Oakland, Seattle, Portland, Houston, Tulsa, New York

Colorado Mainline Approved; Canadian River Purchase Denied

Colorado Interstate Gas Co., Denver, and Candian River Gas Co., Amarillo, have received a go-ahead from the FPC to construct pipeline facilities which will carry additional gas to the Rocky Mountain market area, but the commission has denied Colorado's plan to acquire and operate Canadian's facilities in the manner prescribed in the firm's joint application.

A 215-mile, 20-in. line from the West Panhandle (Texas) field to Colorado's Kit Carson (Colorado) compressor station and a 4800-hp station at the line's southern terminus, a gasoline plant, and a dehydration plant will be built. Estimated cost of construction is $10,160,200 plus $3,697,400 in production and gathering facilities.

The commission has reopened the proceedings for hearing testimony on the reasonableness of payments by Colorado to Southwestern Development Co., which controls Canadian River, for acquisition of Canadian's facilities. Colorado Interstate wanted the facilities to secure an adequate financing base for the proposed construction. No hearing date was set.

FPC Cuts Red Tape for New York-Texas Eastern Storage Plan

Intermediate decision procedure in the gas storage application of New York State Natural Gas Corp. and Texas Eastern Transmission Corp. has been waived by the FPC to speed action on the proposal. Both applicants agreed to omit oral argument and the commission staff counsel concurred in the motion. Counsel for the intervenors, Tennessee Gas Transmission Co. and Transcontinental Gas Pipe Line Corp., objected, however.

Initial briefs were to be filed by Aug. 14 and reply briefs by Aug. 28.

Texas Eastern and New York State Natural want to acquire, develop and operate underground storage facilities in Westmoreland county, Pa., at a total cost of $40,772,922. In connection with the project, New York would build 70 miles of line, Texas Eastern would build 35 miles, and the applicants would jointly construct a 30,000-hp compressor station in the Oakford, Pa., area.

United Gas Proposes Big Pipeline Expansion

A $111,510,000 project, part of a long-range plan to meet increasing demands, has been submitted to the FPC by United Gas Pipe Line Co., Shreveport. The program eventually will include construction of 1130 miles of line, but the present application is for 1005 miles in Texas, Louisiana, and Mississippi, which would increase delivery capacity of the system by more than 800 MMcf daily.

Plans call for about 510 miles of 30-, 26-, and 24-in. line from the Agua Dulce field in south Texas to the Monroe, La., area; 245 miles of 20- to 30-in. line from the Gulf of Mexico to United's Jackson, Miss., compressor station; 215 miles connecting the proposed line with various producing areas and extending to Texas Eastern Transmission Corp.'s facilities near Kosciusko, Miss.; and 24 miles of 16-, 12-, and 8-in. line to connect fields in southern Louisiana with the new facilities.

The FPC has scheduled a hearing for Sept. 11.

El Paso's Mohave Line Under Construction

El Paso Natural Gas Co. is under way on its 451-mile line from the San Juan Basin to a connection with its existing system near the Arizona-California border in Mohave county, Ariz., following FPC approval in late July. Field headquarters have been established at Gallup, N.M., and Flagstaff, Ariz., and negotiations have been completed for a 218-mile right-of-way across the Navajo Indian reservation in Arizona.

A preliminary construction permit issued by the Navajo tribal chairman and the general superintendent of the reservation stipulates that El Paso is to be considered a common carrier for gas which may be produced on Indian lands, and that the Navajos may tap the line for up to 5 MMcf daily for their own consumption; also, Indian labor must be used for construction wherever possible.

The project will allow El Paso to deliver 150 MMcf daily to Pacific Gas & Electric Co. at a point near Topock, Ariz. PG&E was authorized to install 32,160 additional compressor horsepower on its Topock-Milpitas line to increase its take from El Paso from 250 to 400 MMcf.

Estimated cost of the El Paso project is $44.5 million, and the PG&E facilities will cost $7.8 million. Construction is to be completed not later than Jan. 1, 1952.

In addition, El Paso will sell and deliver 17 MMcf daily to Southern Union Gas Co. for resale in Gallup and in seven Arizona towns. The commission denied a request of Interstate Natural Gas Co., Los Angeles, that El Paso and PG&E be designated common carriers.

El Paso's financing arrangement was termed "not reasonable" by FPC, however, and the company must submit a revised plan.

PG&E, according to the FPC order, must sell and deliver natural gas to California-Pacific Utilities Co., Southwest Gas Corp. Ltd., and the U. S. Air Force for its Muroc (Calif.) air base. California-Pacific now supplies manufactured gas to Needles, Calif., and Southwest Gas distributes LP-Gas in Barstow and Victorville, Calif., and territory adjacent to the Victorville air base and the Marine Corps base near Nevo, Calif.

New Compressors to Boost Deliveries in Arkansas

A $1,507,000, 7000-hp compressor station to be built near Blanchard, La., by Arkansas Louisiana Gas Co., Shreveport, has been authorized by FPC. This station will enable the company to transport Texas and Louisiana gas to additional retail customers in central Arkansas and to up the pressures at which gas is delivered to present customers.

PIPE DOPE . . .

Hey, Hoib! Dey ain't never seen a Christmas tree.

Company Formed to Supply Southwestern Colorado

General Petroleum Corp., Los Angeles, has announced plans to form a new company which will tap the isolated Piceance Creek gas field in a remote corner of Colorado to supply fuel to the Public Service Co. of Colorado for distribution to Grand Junction, Colo., and other Colorado river valley cities.

The Grand Valley Pipeline Co. will be formed by General Petroleum, M. B. Garman, and Public Service Co. of Colorado, each party to have a one-third interest in the line.

President of the new company will be P. S. Magruder, executive vice president of General Petroleum; Mr. Garman will serve as vice president and secretary; and F. T. Parks, Public Service Co.'s vice president in charge of operations, will be vice president and treasurer.

Final plans for the pipeline route and choice of construction personnel were scheduled for discussion in Grand Junction on Sept. 1.

Texas Gas Receives Temporary Certificate for River Crossings

Texas Gas Transmission Corp., Owensboro, Ky., has received temporary FPC authorization to construct two 20-in. submarine crossings of the Mississippi river near Greenville, Miss., at a cost of $1,457,959.

A temporary okay also has been given to the company to install and operate 9960 hp at existing and new stations on its system in order to transport additional gas to Texas Eastern Transmission Corp., Shreveport. A new 4500-hp station will be built in Kentucky; and 5460 additional horsepower will be installed at four existing stations in Tennessee and Kentucky. Estimated cost of this project is $2,108,887.

Concurrently, Texas Eastern was given temporary permission to deliver additional gas to its customers west of compressor station No. 20 in southwestern Pennsylvania.

MidSouth's Scheme to Serve East Arkansas Towns Filed

Two applications—one for authorization to acquire existing pipeline facilities and one proposing to construct a system—have been filed with the FPC by MidSouth Gas Co., Little Rock, Ark.

The first, filed jointly by MidSouth and Arkansas Power & Light Co., also of Little Rock, requests that the former company take over AP&L's system serving 20 towns in eastern Arkansas and including 26 miles of main line and distribution pipe. Purchase price has been set at $1,825,200.

MidSouth's second application proposes construction of 240 miles of pipe from a connection with Mississippi River Fuel Corp.'s system at Helena, Ark.

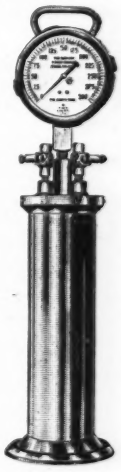
Estimated cost of the system, including the purchase from Arkansas Power & Light, is $10,665,500.

L·P·G

Testing Equipment

for ✓ Propane
✓ Butane
✓ Other L.P. Gasses

8565 VAPOR-PRESSURE BOMB—For Liquefied Petroleum Gas Products. The bomb is a nickel-plated steel cylinder, 3 inches in diameter and 10 inches high, fitted with 2 ⅛-inch liquid-eduction pipes fixed to the head of the bomb, and terminating within ⅛-inch of the bottom of the bomb.
The upper ends of the eduction pipes, which are exposed above the head of the bomb, are fitted with ⅛-inch brass needle valves. The head of the bomb is also fitted with a gauge connection. The bomb is tested for pressures up to 2000 pounds. Furnished complete with a 4½-inch Vapor-Pressure gauge, range 0 to 300 psi., in 1-lb. graduations, ¼-inch copper connecting tube with union fittings and adapter to ⅛-inch N.P.T. Valves.

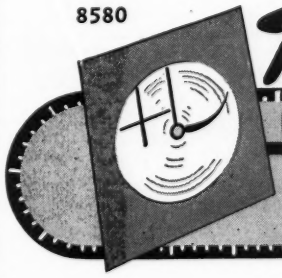


8565-70

8570 SPECIFIC-GRAVITY BOMB—For Liquefied Petroleum Gas Products. Similar in construction to No. 8565, but with a cylinder 12 inches high. The bomb is supplied with a 4½-inch Vapor-Pressure gauge, range 0 to 600 psi, in 2-lb. graduations. The bomb is tested for pressures up to 2000 lbs. Complete with 2 copper connecting tubes with union fittings and adapter to ⅛-inch N.P.T. valves and gauge.

8580

8580 CORROSION TEST BOMB—For Testing Corrosiveness of Liquefied Petroleum Gases. An all stainless steel bomb for corrosion tests by the copper strip method. Sealed by a neoprene "O" ring which makes it possible to make the bomb pressure tight with the hands and **without wrenches.**
Furnished complete with two nickel plated valves, connecting hose with swivel connections, adapter to ¼-inch pipe.



Refinery Supply Co.
621-23 E. 4th St. Tulsa 3, Oklahoma
Laboratory Apparatus
Instruments Chemicals
MANUFACTURER OF R.S. SPECIALTIES

Georgia Natural Resubmits Plan to Serve Tallahassee

Georgia Natural Gas Co., Albany, Ga., has asked for FPC approval of a plan to construct a pipeline system to serve markets in southwestern Georgia and Tallahassee, Fla. The application, similar to one filed by the company last March, and subsequently withdrawn, asks the commission to direct Southern Natural Gas Co. to sell to Georgia Natural an adequate supply of gas for the proposed project.

The new system would connect with Southern Natural's facilities near Phenix City, Ala., and extend to Tallahassee, with laterals or branch lines serving principal cities in southwest Georgia adjacent to the line.

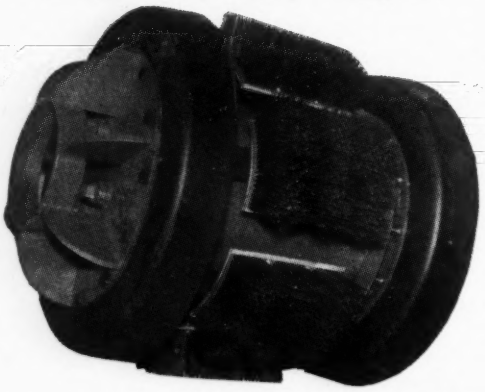
Georgia Natural estimates its annual demand at 9,167,098 Mcf, with estimated maximum day firm demand of 30,000 Mcf.

Ohio Fuel's Dayton Line Okayed

The Ohio Fuel Gas Co., Columbus, has received an FPC okay to construct and operate a 22-mile, 16-in. pipeline in the Dayton, Ohio, vicinity. At the same time the commission authorized the removal of Ohio Fuel's 330-hp Vandalia compressor station near Dayton. Increased investment, after retirement of the Vandalia station, is estimated at $736,212.

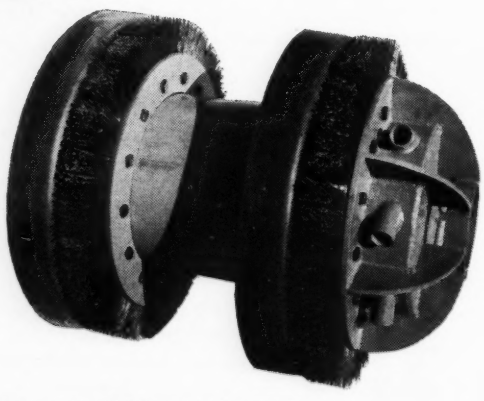
Construction of the line was scheduled to begin Sept. 1 and to be completed Nov. 1. Capacity will be 75 MMcf per day. The company will be able to supply Dayton and other western Ohio areas with high pressure gas received at Centerville from Texas Eastern Transmission Corp.

Williamson Gas Line Pigs* Traverse 1½R 90° Bends



← 24" Size New Design TYPE GP PIGS with Brushes Mounted on Arched Springs to Compensate for Wear

30" Size → Standard Design TYPE RCN-50 with Jet Rotation Feature to Distribute Wear



*Patents Pending

Above Designs Available in 16" and Larger. Other Designs as Small as 2".

THE PIG WITH THE POKE CLEANS PIPE LINES

T. D. Williamson, Inc.

TULSA 9, OKLAHOMA

Pipeline Newsnotes

Transcontinental Gas Pipe Line Corp., Houston, which on April 28 received an FPC okay to increase the capacity of its Texas-New York pipeline and to extend the system's service, has been ordered by the commission to sell natural gas to the South Carolina Gas Co., Gaffney, S. C., and to the cities of Lavonia, Buford, and Sugar Hill, Ga., and to Gainesville, Ga., if the city decides to construct its own distribution system. If Gainesville does not build such a system, Transcon must sell gas to Georgia Gas Co. for distribution there.

Three industrial customers in the Butler, Pa., area soon will be supplied natural gas by Acme Natural Gas Co., which has received FPC authorization to build the necessary facilities. The firms are Armco Steel Corp., Pullman-Standard Car Manufacturing Co., and Fretz-Moon Tube Co. In approving the 20-mile, $539,000 Acme project, FPC also directed The Manufacturers Light & Heat Co., Pittsburgh, to connect its system with the new facilities and to sell and deliver gas to Acme.

A consolidated hearing on applications of Bluefield (W.Va.) Gas Co. and Amere Gas Utilities Co., Charleston, W. Va., to serve natural gas to Bluefield, Va., and Bluefield, W. Va., began Aug. 2 in Washington. Amere would build a $9000 measuring and regulating station at Princeton, W. Va., and would sell natural to Bluefield Gas Co. which would transport it to its own system and the system of its subsidiary, Commonwealth Public Service Corp., through 14.3 miles of line from Princeton. Estimated cost of Bluefield's portion of the project is $230,000.

Progress Reports

Planned

ALGONQUIN GAS TRANSMISSION CO., a 276-mile line from a connection with Texas Eastern's line at Lambertville, N. J., to Boston, with 492 miles of laterals and a compressor station in Middleton, Conn., included.

AMERE GAS UTILITIES CO., Charleston, and **BLUEFIELD (W.VA.) GAS CO.,** for service to Bluefield, Va., and Bluefield, W. Va. Amere, a measuring and regulating station. Bluefield Gas, 14.3 miles of 6⅝-in. and regulating station.

ARKANSAS-LOUISIANA GAS CO., Shreveport, 30.3 miles 8⅝-in. to be built by Crossett (Ark.) Lumber Co. and operated by Ark.-La.

ARKANSAS-MISSOURI POWER CO., Blytheville, Ark. To build line from Big Inch to serve 12 towns in two states. To start within year.

ATLANTIC GULF GAS CO., 1500 miles, Alabama to Florida, Georgia, South Carolina.

CAROLINA NATURAL GAS CORP., Charlotte, N. C., 372 miles, 18 lines, from Transcontinental Gas Pipe Line Corp. main line to North and South Carolina communities.

CITIES OF BOONEVILLE, RIPLEY, BALDWYN, Miss., to connect with Tennessee main line in Benton county, 16 miles of 6-in., 23 more miles, 11-mile tap.

CONSUMERS GAS CO., Toronto, Can., 85 miles, Buffalo to Toronto.

EQUITABLE GAS CO., Pittsburgh, 17 miles of 8- to 16-in., 3520-hp booster, dehydration plant, near Waynesburg, Pa.

GEORGIA NATURAL GAS CO., Albany, Ga., Phenix City, Ala., to Tallahassee with laterals and branches. $5.1 million.

JERSEY CENTRAL POWER & LIGHT CO., Asbury Park, 7 miles.

KANSAS-NEBRASKA NATURAL GAS CO., Phillipsburg, Kan., 1640-hp compressor addition, 4 miles of 2-in.; replace 16 miles of 8-in. with 12-in., 22 miles of 6-in. with 8-in., 8 miles of 4-in. with 6- and 8-in.; loop 6 miles.

LAKE SHORE PIPELINE CO., ERIE GAS SERVICE CO. INC., and GRAND RIVER GAS TRANSMISSION CO., pipelines from a Meadville, Pa., connection with Tennessee Gas Transmission's line westward to Ohio.

MANUFACTURERS LIGHT & HEAT CO., CUMBERLAND & ALLEGHENY GAS CO., NATURAL GAS CO. OF W. VA., and HOME GAS CO. Manufacturers: 44 miles 4- and 16-in. in Ohio, Pa., and W. Va., and two 500-hp units. Cumberland: 10.3 miles 6- and 8-in. and a 65-hp station in W. Va. Natural Gas Co.: 4.5 miles of 4-, 6-, and 8-in. in Ohio. Home: meter and regulating station in Rockland county, N. Y.

MIDSOUTH GAS CO., Little Rock, 240 miles northerly from Helena, Ark.

MISSISSIPPI RIVER FUEL CORP., St. Louis, for compressor units totaling 28,380 hp in seven new stations.

NEVADA NATURAL GAS PIPE LINE CO., 122 miles of 10¾-in. line from Topock, Ark., to Las Vegas, Nev.

NEW YORK STATE NATURAL GAS CORP., New York, 70 miles of 20-in. from Westmoreland county, Pa., to connection with Big Inch; 63 miles of 20-in., from Westmoreland county to Pennsylvania-Ohio line to connect with East Ohio Gas Co., Cleveland.

NORTHEASTERN GAS TRANSMISSION CO., pipeline to Massachusetts, Connecticut, Rhode Island, Maine, Vermont, and New Hampshire. In all, 501 miles of 3- to 20-in. line, in loops and laterals, in New England.

NORTHWEST NATURAL GAS CO., for 700 miles in Washington, Idaho, Oregon.

OHIO FUEL GAS CO., Columbus, 6 miles 18-in. sectional replacements between Sugar Grove and Mt. Sterling to be completed in Sept.; 22 miles 20-in. vicinity of Fremont and Lime City, Nov. completion expected.

PACIFIC NORTHWEST PIPELINE CORP., 2175 miles of 26-in. from southern Texas to Seattle, Wash., Vancouver, B.C., via Oklahoma, Kansas, Colorado, Wyoming, Idaho, Oregon, Washington.

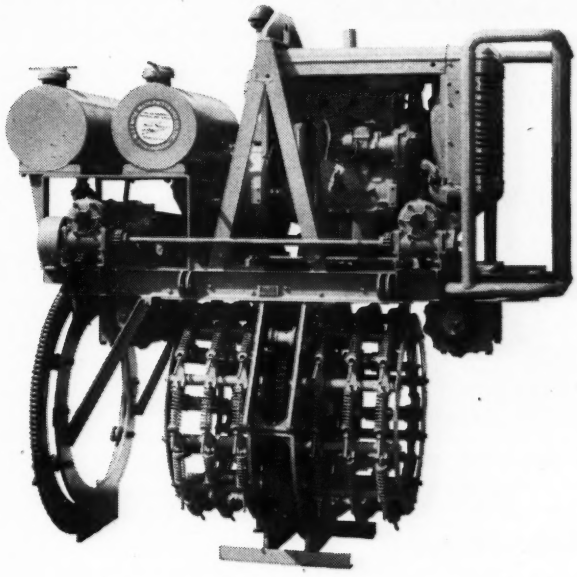
PANHANDLE EASTERN PIPE LINE CO., Kansas City, Mo., for 185 miles and 16,000 hp in compressor stations.

PEOPLES NATURAL GAS CO., Pitsburgh, 16 miles of 8- and 10-in., from Tennessee Gas spur in Big Beaver to borough of Midland, Beaver county, Pa. Start July, complete August.

PIEDMONT NATURAL GAS CO. INC., Spartanburg, S. C., six laterals totaling 74 miles from Transcontinental main line to North and South Caroline cities.

PUBLIC SERVICE CO. OF COLORADO, pipeline from the Piceance Creek field in western Colorado to Grand Junction and Rifle.

For Cleaning and Lineup



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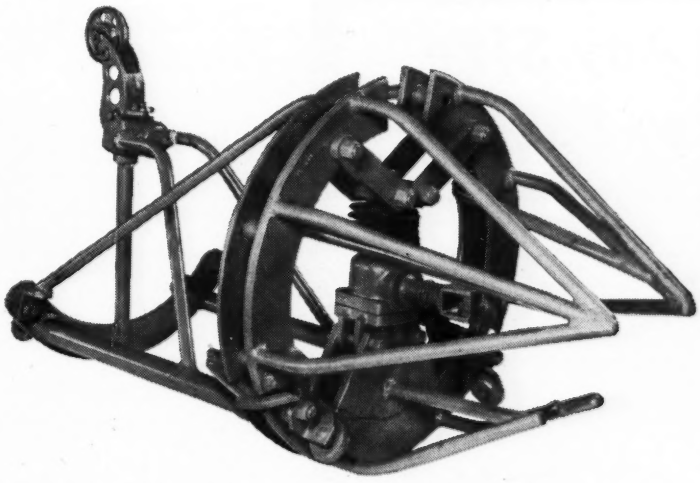

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PUBLIC SERVICE CO. OF NORTH CAROLINA INC., Gastonia, 365 miles connecting at 10 points with Transcontinental main line in North and South Carolina.

SHENANDOAH GAS CO., Lynchburg, Va., for 49 miles from near Cedarville, Va., to cities in Virginia and West Virginia.

SOUTH CENTRAL ALABAMA NATURAL GAS CO. INC., 150-mile pipeline from a connection with Southern Natural's line in Elmore county.

SOUTHEASTERN MICHIGAN GAS CO., Chicago, 55 miles of 12-in. from connection with Panhandle Eastern main line in Oakland county, Mich., to Marysville, Mich.

SOUTH GEORGIA GAS CO., Atlanta, for 248 miles: Talbot county to Brooks county, 144 miles, plus 104 miles of laterals.

SOUTH JERSEY GAS CO., Atlantic City, 77 miles, Camden to Atlantic City.

SOUTHERN UNION GAS CO., Dallas, for 15 miles of 10-in. and 12-in. from Kutz canyon to Blanco gas field, N. Mex.

TEXAS EASTERN TRANSMISSION CORP., Shreveport, to boost capacity to 476 MMcf, 791 miles 30-in. from Kosciusko, Miss., to Connellsville, Pa.; seven compressor stations with 46,400 hp on new line, six with 52,500 hp on existing line; short lines in New York area; 35 miles of 30-in. from Fayette county, Pa., to Westmoreland county, Pa.

TRANSCONTINENTAL GAS PIPE LINE CORP., Houston, 11-mile mainline extension, 20- to 26-in. pipe, East Carteret, N. J., to Brooklyn.

UNITED FUEL GAS CO., Charleston, W. Va., 5.5 miles, 6450-hp compressor stations to deliver gas to storage pools in West Virginia.

UNITED GAS PIPE LINE CO., Shreveport, 1005 miles in Texas, Louisiana, and Mississippi. Includes 451 miles 30-in., 6 miles 26-in., 53 miles 24-in. from Agua Dulce field in south Texas to Monroe, La.; about 245 miles of 30, 26, 24, and 20-in. from Gulf of Mexico northeast to Jackson, Miss.; 215 miles from this line to near Kosciusko, Miss.; 24 miles 8, 12, and 16-in. in south Louisiana; 16 miles of 16-in. from Koran gasoline plant site, La., to its Carthage-Sterlington line in Louisiana; 4000-hp compressor, dehydration plant.

VALLEY GAS PIPE LINE CO. INC., Houston, $144.5 million, 1000 miles of 30-in., from Hardin county, Texas, to southern Michigan, plus 500 miles of 24-in. in Texas and Louisiana, plus laterals, two 13,500-hp compressor stations, plus others aggregating 70,000 hp. Wants to start by Dec. 31, complete April 1, 1952.

Approved

ACME NATURAL GAS CO., Butler, Pa., 26 miles of 6- to 10-in. line, local.

ARKANSAS-LOUISIANA GAS CO., Shreveport, to install a 7000-hp compressor station on its system near Blanchard, La.

CENTRAL KENTUCKY NATURAL GAS CO., Charleston, W. Va., for 32 miles, 20-in. loop from North Means, Ky., to Nicholas county, Ky.; one compressor in North Means station. To serve Cincinnati.

CITIES SERVICE GAS CO., Oklahoma City, for 3000 added horsepower in existing stations, a new 690-hp station in Kansas storage fields.

COLORADO INTERSTATE GAS CO., 215-mile, 20-in. line from the West Panhandle area of Texas to the company's Lakin, Kan. compressor station, and a 4800-hp compressor station.

EAST OHIO GAS CO., Cleveland, two 8-in. lines totaling 12 miles, a 940-hp compressor station, and underground facilities.

MICHIGAN-WISCONSIN PIPE LINE CO., Detroit, 139,200 hp additional on mainline.

MISSISSIPPI RIVER FUEL CORP., St. Louis, 4100 hp in existing stations in Louisiana, Arkansas, Missouri. Four 12-in. river crossings 40 miles from Dubach, La., to Perryville.

OHIO FUEL GAS CO., Columbus, 22 miles of 16-in. near Dayton, remove 330-hp Vandalia compressor station. Line to be completed in Nov.

TENNESSEE NATURAL GAS LINES INC., Nashville, 24 miles of line and 4 meter and regulator stations, near Nashville. To be completed Dec. 1.

TEXAS GAS TRANSMISSION CORP., Owensboro, Ky., 9960-hp in existing and new compressors in Tennessee and Kentucky, to serve Texas Eastern.

TEXAS GAS TRANSMISSION CORP., Owensboro, two 20-in. lines under Mississippi river near Greenville, Miss.

Contracts Let

EAST OHIO GAS CO., Cleveland, to Williams Bros. Corp. for 24 miles 20-in. in Mahoning county, Ohio. Construction to start Sept. 15 and be completed Nov. 1950.

HOPE NATURAL GAS CO., Clarksburg, W. Va., to Pipe Line Construction & Drilling Co., Huntington, W. Va., for 19.5 miles of 18-in. from Tonkin station, Doodridge county to Fink storage, Lewis county, W. Va.

MISSISSIPPI RIVER FUEL CORP., St. Louis, to Mary Construction Co., Cape Girardeau, Mo., for 40 miles 18-in., Dubach to Perryville, La.; 3.2 miles 24-in. and four 12-in. manifold crossings of Mississippi river in metropolitan St. Louis. To be completed Sept. 30.

SOUTH JERSEY GAS CO., Atlantic City, N. J., to G. G. Griffis Inc., Tulsa, for 72½ miles of 8, 10, 12, and 16-in. To be completed by Oct. 10.

Under Way

ALABAMA-TENNESSEE NATURAL GAS CO., 70-mile line from Muscle Shoals, Ala., to Decatur and Huntsville.

ARKANSAS-LOUISIANA GAS CO., Shreveport. About 91 miles — Magnolia, Ark., to Malvern, Ark. — completed on the 163-mile, 20-in. Waskom, Texas, to Malvern line. Anderson Brothers Construction Co., Houston.

COMMONWEALTH NATURAL GAS CORP., Richmond, Va., 104 miles of 18-in., 84 miles of 12-in., 20 miles of 8-in., 20 miles to laterals. Ray L. Smith & Son Inc., El Dorado, Kan.

CONSOLIDATED EDISON OF NEW YORK INC., BROOKLYN UNION GAS CO., KINGS COUNTY LIGHTING CO. are building lines to receive gas from Transcontinental's Texas - New York line. ConEd will build 23 miles, Brooklyn will construct 12 miles, and Kings County will build 2.9 miles.

EAST TENNESSEE NATURAL GAS CO. is building 400 miles of 16-in. and 12¾-in. line from Lobelville, Tenn. to Oak Ridge. The job, including miscellaneous laterals, will be completed Oct. 1.

EL PASO NATURAL GAS CO., line from San Juan basin, New Mexico, to Topock, Ariz. Work began last month near Farmington, N.M. on the 433-mile, 24-in. line. To be completed Jan. 1.

LACLEDE GAS CO., St. Louis, started May 31, 22- to 30-in. line, in city and county. Frazier-Davis Construction Co., contractors. To complete by November.

MICHIGAN GAS STORAGE CO., Detroit, 83 miles 22-in. Ovid, Mich., to Muskegon river, started Aug. 1, to be completed Nov. 15. Right-of-way prepared, trenching started Aug. 12. Foundations poured for 7600-hp compressor station near Marion, Mich.; to be completed Dec. 1. Mahoney Contracting Co.

MONTANA-DAKOTA UTILITIES CO., a 340-mile line from Worland, Wyo. to Cabin Creek, Mont.; includes a compressor and dehydration plant at Worland. Conyes Construction Corp.

MONTANA POWER CO., Butte, 80 miles 12-in., Bozeman to Butte. Parkhill Truck Co. stringing for C. N. Deaton.

NORTHERN NATURAL GAS CO., Omaha, under way on 597 miles of mainline loops. 155 miles